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ABSTRACTS

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ABBREVIATED TITLES USED IN THE ABSTRACTS

Abbreviated Title.	*Journal.*
Aircr. Engng	Aircraft Engineering.
Ann. Min. Belg.	Annales des Mines de Belgique.
Ann. Min. Roumanie	Annales des Mines de Roumanie.
Ann. Off. Combust. liq.	Annales de l'Office National des Combustibles Liquides.
Asph. u. Teer	Asphalt und Teer.
Auto. Engr	Automobile Engineer.
Auto. Tech. Z. (Berlin)	Automobiltechnische Zeitschrift (Berlin).
Azerb. neft. Khoz.	Azerbaidzhanskoe Neftyanoe Khozyaistvo.
Beitr. angew. Geophys.	Beitrage angewandte Geophysik.
Beitr. Geophys.	Beitrage zur Geophysik.
Bitumen	Bitumen.
Bohrtech. Z.	Bohrtechniker Zeitung.
Bol. Geol. y Min. (Caracas)	Boletin de Geologia y Mineria (Caracas).
Bol. Inform. Petroleras (B.A.)	Boletin de Informaciones Petroleras (Buenos Aires).
Boll. Soc. geol. ital.	Bolletin de la Societa Geologica Italiana.
BrennstChemie	Brennstoff Chemie.
Bull. Acad. Sci. (U.S.S.R. Inst. Seismol.)	Bulletin of the Academy of Sciences (U.S.S.R. Institute of Seismology).
Bull. Amer. Ass. Petrol. Geol.	Bulletin of the American Association of Petroleum Geologists.
Bull. Amer. geol. Soc.	Bulletin of the American Geological Society.
Bull. Ass. franç. Tech. Pétrol.	Bulletin de l'Association Français des Techniciens du Pétrole.
Bull. Inst. Min. (metall.) Engrs	Bulletin of the American Institute of Mining and Metallurgical Engineers.
Bull. Math. Phys. Éc. polyt. Bucharest	Bulletin de Mathematique et de Physique, Bucharest (École-polytechnique).
Bull. roum. geol. Soc.	Bulletin of the Roumanian Geological Society.
Bull. seismol. Soc. Amer.	Bulletin of the Seismological Society of America.
Bull. Univ. Texas (Bur. econ. Geol. Techn.)	Bulletin of the University of Texas (Bureau of Economic Geology and Technology).
Bur. Stand. J. Res., Wash.	United States Bureau of Standards Journal of Research, Washington.
Calif. Oil World	California Oil World.
Canad. J. Res.	Canadian Journal of Research.
Canad. Min. J.	Canadian Mining Journal.
Canad. Min. metall. Bull.	Bulletin of the Canadian Institute of Mining and Metallurgy.
Chem. & Ind.	Chemistry and Industry.
Chem. Rev.	Chemical Reviews.
Chem. Tr. J.	Chemical Trade Journal.
Chem. Wkbld	Chemische Weekblad.
Chim. e Industria	La Chimica e l'Industria.
Chim. et Ind.	Chimie et Industrie.
C.R. Acad. Sci. (Paris)	Comptes Rendus hebdomadaires des Seances de l'Academie des Sciences (Paris).
C.R. Geol. Pétr. (Strasbourg)	Compte-Rendu des Seances du Groupe des Geologues Pétroliers de Strasbourg.
Diesel Eng. Us. Ass.	Diesel Engine Users Association.
Direccion Minas y Geol.	Publication of Direccion Minas y Geologicas (Argentine).
Econ. Geol.	Economic Geology.
Engineer	Engineer.
Engineering	Engineering.
E.P.	English Patent.
Fuel	Fuel in Science and Practice.
Gas Oil Pwr	Gas and Oil Power.
Geol. Mag. (Lond.)	Geological Magazine (London).
Geophys.	Geophysics.
Glückauf	Glückauf.

Abbreviated Title.	*Journal.*
Groz. Neft.	Groznenskii Neftyanik.
Industr. Engng Chem.	Industrial and Engineering Chemistry.
Industr. Engng Chem. Anal.	Industrial and Engineering Chemistry, Analytical Edition.
Industr. Pwr & Fuel Econ.	Industrial Power and The Fuel Economist.
Instruments	Instruments.
Int. Z. Bohrtech.	International Zeitschrift für Bohrtechnik.
J. Amer. chem. Soc.	Journal of the American Chemical Society.
J. appl. Chem. (U.S.S.R.)	Journal of Applied Chemistry, U.S.S.R.
J. appl. Phys.	Journal of Applied Physics.
J. chem., metall. min. Soc. S. Africa	Journal of the Chemical, Metallurgical and Mining Society of South Africa.
J. chem. Soc.	Journal of the Chemical Society.
J. Fuel Soc. Japan	Journal of the Fuel Society of Japan.
J. Geol.	Journal of Geology.
J. Inst. Fuel	Journal of the Institute of Fuel.
J. Instn auto. Engrs	Journal of the Institution of Automobile Engineers.
J. Instn Petrol. Tech.	Journal of the Institution of Petroleum Technologists.
J. org. Chem.	Journal of Organic Chemistry.
J. phys. Chem.	Journal of Physical Chemistry.
J. R. aero. Soc.	Journal of the Royal Aeronautical Society.
J. Soc. aut. Engrs	Journal of the Society of Automotive Engineers.
J. Soc. chem. Ind.	Journal of the Society of Chemical Industry.
Khim. Tverd. Topliva	Khimiya Tverdovo Topliva.
Kop. Naft. Polsce	Kopalnictwo Naftowe w Polsce.
Lubr. Maint. & Petrol. Mkr	Lubrication Maintenance and the Petroleum Marketer.
Matières grasses	Matières Grasses.
Min. & Metall.	Mining and Metallurgy.
Min. Mag. (Lond.)	Mining Magazine (London).
Monit. Pétr. roum.	Moniteur du Pétrole Roumain.
Montan. Rdsch.	Montanistische Rundschau.
Nat. Petrol. News	National Petroleum News.
Nature	Nature.
Neft. Khoz.	Neftyanoe Khozyaistvo.
Nickel Ind.	Nickel Industry.
Nov. Neft.	Novosti Neftepererabotki.
Nov. Tekhn. Bur.	Novosti Tekhniki Bureniya.
Nov. Tekhn. Neft.	Novosti Tekhniki Neftedobvicki.
Oel u. Kohle	Oel und Kohle vereinigt mit Erdoel und Teer.
Oil Gas J.	Oil and Gas Journal.
Oil News (London)	Oil News (London).
Oil Wkly	Oil Weekly.
Ole, Fette, Wachse	Ole, Fette, Wachse, Seife, Kosmetik.
Olii min.	Olii Minerali.
Paint Mnfr.	Paint Manufacture.
Paint Technol.	Paint Technology.
Petrol. Engr	Petroleum Engineer.
Petrol. Tech. (A.I.M.M.E.)	Petroleum Technology (American Institute of Mining and Metallurgical Engineers).
Petrol. Times	Petroleum Times.
Petrol. World (L.A.)	Petroleum World (Los Angeles).
Petrol. World (Lond.)	Petroleum World (London).
Petrol. Z.	Petroleum Zeitschrift.
Physics	Physics.
Pipe Line News	Pipe Line News.
Proc. Amer. Petrol. Inst.	Proceedings of the American Petroleum Institute.
Proc. Amer. Soc. Test. Mater.	Proceedings of the American Society for Testing Materials.
Proc. Ass. Asph. Pav. Technol.	Proceedings of the Association of Asphalt Paving Technologists.
Proc. Instn mech. Engrs	Proceedings of the Institution of Mechanical Engineers.
Proc. phys. Soc. (Lond.)	Proceedings of the Physical Society (London).
Proc. roy. Soc.	Proceedings of the Royal Society.

Abbreviated Title.	*Journal.*
Przeg. Chem.	Przeglad Chemiczny.
Przem. Naft.	Przemysl Naftowy.
Quart. J. geol. Soc. Lond.	Quarterly Journal of the Geological Society of London.
Rds & Rd Constr.	Roads and Road Construction.
Rec. Trav. chim. Pays-Bas	Receuil des Travaux Chimiques des Pays-Bas.
Refin. nat. Gasol. Mnfr	Refiner and Natural Gasoline Manufacturer.
Rev. Comb. liq.	Revue des Combustibles Liquides.
Rev. Pétrolif.	La Revue Pétrolifère.
Rev. sci. Instrum.	Review of Scientific Instruments.
Riv. ital. Petrol.	La Rivista Italiana del Petroleo.
S. Afr. Min. (Engng) J.	South African Mining and Engineering Journal.
Strade	Strade.
Sulz. tech. Rev.	Sulzer Technical Review.
Summ. Ops, Calif. Oil Flds	Summary of Operations, Californian Oil Fields.
Tech. Phys. U.S.S.R.	Technical Physics of the U.S.S.R.
Tekn. Tidskr.	Teknisk Tidskrift.
Terr. Magn.	Terrestrial Magnetism.
Trans. Amer. geophys. Un.	Transactions of the American Geophysical Union.
Trans. Amer. Inst. Min. & Metall.	Transactions of the American Institute of Mining and Metallurgy.
Trans. Faraday Soc.	Transactions of the Faraday Society.
Trans. Inst. mar. Engrs	Transactions of the Institute of Marine Engineers.
Trans. Instn min. Engrs	Transactions of the Institution of Mining Engineers.
U.S. Bur. Mines, Inf. Circ.	United States Bureau of Mines, Information Circular.
U.S. Bur. Mines, Rep. Invest.	United States Bureau of Mines, Report of Investigations.
U.S. Bur. Mines, Tech. Paper	United States Bureau of Mines, Technical Paper.
U.S. Geol. Surv. Bull.	United States Geological Survey Bulletin.
U.S.P.	United States Patent.
World Petrol.	World Petroleum.
Z. dtsch. geol. Ges.	Zeitschrift der Deutschen Geologischen Gesellschaft.
Z. Geophys.	Zeitschrift für Geophysik.
Z. prakt. Geol.	Zeitschrift zur Praktische Geologie.
Z. ver. dtsch. Chem.	Zeitschrift Vereins deutscher Chemiker.

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Geology.

1. Stratigraphy versus Structure in Rocky Mountain Region. R. L. Heaton. *Bull. Amer. Ass. Petrol. Geol.*, 1937, **21**, 1241–1267.—Although most of the oil- and gas-fields of the Rocky Mountain region are on closed anticlines, there are several fields which owe their existence to stratigraphic conditions.

In view of this, a systematic survey is undertaken of the relationships between palæogeography and source-beds and accumulation. The palæogeographic conditions obtaining in the Pennsylvanian, Permo-Pennsylvanian, Permian, Triassic, Jurassic and Cretaceous formations are dealt with in detail and illustrated by maps.

The inherent influence of what the authors term the "Ancestral Rockies" is discussed. There are possibilities of finding lenticular and wedging sand bodies on the flanks of major structures, but the discovery of these will require detailed stratigraphic work. G. S. S.

2. Water-Insoluble Residues in Rock Salt of Louisiana Salt Plugs. R. E. Taylor. *Bull. Amer. Ass. Petrol. Geol.*, 1937, **21**, 1268–1310.—In the course of work on the cap rock of Louisiana salt domes, an examination was made of the water-insoluble residues from certain Gulf Coast localities. This work having shown that the residues were complex in mineral composition, samples were collected and studied from 20 localities: 17 in Louisiana, two in Texas and one in Mississippi.

The amount and character of the residues are similar to those determined from samples of rock salt from Germany and average between 5 and 10% by weight of the rock. Although the dominant feature of the residues is the presence of a high percentage of anhydrite, the following minerals, among others, are also recorded: dolomite, calcite, pyrite, quartz, iron ores, sulphur, celestite, barite, kaolinite, gypsum, magnesite and boracite.

Sand inclusions from Avery and Jefferson Islands were subjected to mechanical and petrographic analysis, and show that they differ sufficiently from known sands of the Gulf Coast to permit any correlation being made.

It is concluded that if this same assemblage of water-insoluble minerals which characterizes the salt plugs occurs in the associated cap rock, definite evidence indicating the formation of cap rock through accumulation of water-insolubles in the salt will have been established.

Many photomicrographs of mineral grains, much tabulated matter relating to the residues, and a very full bibliography (totalling nearly 80 entries) are contained in the paper. G. S. S.

3. Mechanical Sand Analyses for Correlation. I. I. Gardescu and M. H. Billings. *Bull. Amer. Ass. Petrol. Geol.*, 1937, **21**, 1311–1332.—This paper summarizes the results obtained by the use of an improved method of recording sand and palæontological analyses of samples. The method has proved accurate, and presents much flexibility and adaptability to changing sedimentary conditions. The samples were taken from well cores from a piercement type salt dome in S.E. Texas.

In obtaining the screen analyses, mechanical shaking was employed; this, compared with hand-shaking, was found to be much more thorough and reliable. A set of fifteen sieves, 3 in. in diameter, were used; the wire specifications and other like data are shown in tabular form.

The results from the analyses and palæontological data obtained from examination of the samples were plotted on transparent, punched index cards. By the use of these index charts, correlations are made possible between two producing horizons on the flank of the dome. Further detailed study led to additional information relating to deposition and to the establishment of the geological history of the lowermost sediments of the Miocene.

Correlating index charts of various sand zones accompany the paper.

G. S. S.

4. Application of X-ray Crystal Analysis to a Problem of Petroleum Geology. D. H. Reynolds, E. A. Means, and L. G. Morgan. *Bull. Amer. Ass. Petrol. Geol.*, 1937, **21**, 1333–1339.—The powder method of crystal analysis by X-ray diffraction has been

directed to certain oil-well samples from a number of geological horizons of Western Kansas.

Each chemical compound or mineral gives rise to a diffraction pattern which is unique for that substance. For a mixture of minerals, each species present gives its own pattern, the resulting pattern being made up of the super-imposed patterns of all the individual minerals occurring.

The data for sediments, from wells somewhat widely separated geographically, show a definite correlation between the type X-ray diffraction pattern obtained and the member of the formation from which the sample was procured. Types of diffraction patterns for various limestone beds encountered at different levels in a single hole are tabulated.

The method is considered to have great possibilities for the petroleum geologist in directing drilling operations. G. S. S.

5. Studies of Source-Beds in Oklahoma and Kansas. P. D. Trask. *Bull. Amer. Ass. Petrol. Geol.*, 1937, **21**, 1377–1402.—As a possible means of recognizing petroleum source-beds, eight properties of sediments from various parts of the United States were investigated for significant differences. Certain sediments came from near oil zones and others far from oil zones; many thousands of samples were analysed. Of the eight properties investigated, that of the nitrogen-reduction ratio was proved to be the most important. The ratio was found to be low in sediments near to oil zones and high in those far from oil zones.

The other properties or characteristics are also discussed, viz.: carbon content, colour, reducing power, oxidation factor, volatility, degree of volatility, and carbon–nitrogen ratio. Of these, the first four proved to be approximately the same in sediments near and far from oil zones, and thus of little value as indices of source-beds. The remaining three properties were found to be more useful from this point of view, as they were noted to be rather more pronounced in sediments near oil zones than in those far from such zones.

The nitrogen-reduction ratio property—the ratio of the nitrogen content to the reducing power—appears, however, to be the main and more encouraging characteristic. It exhibits a definite and distinct relationship to the present occurrence of oil in Oklahoma and Kansas; in effectiveness it appears to be 65–75% for the strata studied.

It is concluded that even if a genetic relationship to the generation of oil is not apparent, the inference appears to be warranted that if sediments possess low nitrogen reduction ratios, there are good possibilities that accumulation will occur in the area, provided structure and reservoir conditions are favourable. G. S. S.

6. Pennsylvanian Sedimentation in Arkansas Coalfield. T. A. Hendricks. *Bull. Amer. Ass. Petrol. Geol.*, 1937, **21**, 1403–1421.—The Arkansas coalfield is situated on the north flank of the large Pennsylvanian geosyncline of the Ouachita Mountains of Arkansas and Oklahoma. The probable conditions of deposition and source of sediments is discussed as suggested by the lithology and lateral extent of the individual beds, by the stratigraphical relationship between the types, and by the nature of the variations in thickness.

The oldest formation of the geosynclinal facies in the field—the Atoka—is present beneath the entire area. The younger formations—Hartshorne Sandstone, McAlester Shale, Savanna Sandstone and Boggy Shale—are absent owing to erosion having taken place over much of the region.

The Atoka consists of alternating sandstones and shales, with a few lenticles of coal. It varies in thickness from 4450 ft. in the north to 9000 ft. in the south; the thickening is most marked towards the base of the series, and this is figured in a diagram showing correlations of various horizons.

The deposition of Pennsylvanian strata occurred in a basin: (1) that was progressively warped downward and the north margin of which migrated northward across the area, but lay across the central portion of the field during much of early Atoka time; (2) underwent minor deformation by compressive pressure from the south during deposition of strata; (3) stood near to sea-level during the major part of the deposition period; (4) were not subjected to incursion of marine waters likely

to leave a discernible record in the stratigraphic column; (5) received the bulk of deposits under fluviatile conditions.

As a result, the area is characterized by: (*a*) northward thinning of the beds; (*b*) a marked change in the structural pattern along an E.–W. line, probably marking the zone of greatest change in thickness of the coal-basin strata; (*c*) limited lateral extent of lithologic units; and (*d*) no apparent symmetry of recurrence of lithologic types in the stratigraphic column. G. S. S.

7. Aerial Photography Used Extensively in New Guinea Oil Search. Anon. *World Petrol.*, Oct. 1937, **8** (10), 44–47.—On account of the extent, inaccessibility and need for rapid work, aerial photography has been adopted to give topographical maps of oil concessions held in the Netherlands New Guinea. This has the advantage of providing some geological data at the same time. Landing-grounds were chosen at Babo, Sorong, Seroei and Mimika. Their preparation involved overcoming many difficulties, and at Seroei resort was made to a base for amphibians. Three aeroplanes and two seaplanes were used in the survey.

Photographs were taken with a nine-lens panorama camera having an angle of view of 140°. A Zeiss wide-angle camera had an angle of view of 90°. Both cameras gave negatives 18 cm. by 18 cm.; the former gave a scale of 1 : 80,000, the latter 1 : 40,000. The main use of the panorama camera was to make a navigation map for the flying of the Zeiss camera runs. The two were used in conjunction for about 5,600,000 hectares. Then it was found that the panorama camera was no longer indispensable, and the remaining area was mapped with the Zeiss camera alone.

The Zeiss-camera photographs were used for the geological–topographical elaboration, and in part of the area also for geodetic elaboration. Along the coast at distances of from 60 to 120 ml. astronomical stations were observed and ground was marked. These stations and the base-lengths measured in their neighbourhood served as bases for the aerial triangulation. In this way the co-ordinates of the principal and auxiliary points on the photographs were obtained.

The flying altitude was 13,000 ft., and for the best results it was necessary for the sky to be practically cloudless. The best time of the day was between seven and eight o'clock in the morning. On an average only about 30 min. of favourable weather occurred per day. By the middle of 1937 90% of the mapping had been completed.

Five geological parties are working on regional investigations. Maps incorporating all the topographical and geological data derivable from the aerial photographs are used by the field geologists. Field work has confirmed various structures deduced from the photographs.

A gravity survey of the swamps has been begun. G. D. H.

8. Some Results from the Drilling of Lunlunta No 2 Well (Mendoza). J. C. Yussen de Campana. *Bol. Inform. Petroleras* (*B.A.*) Sept. 1937, **14** (157), 17–48.—The first wells drilled in the province of Mendoza were located on the studies of Stelzner, who visited the region in 1873 and noted the existence of oil seeps and asphalt deposits in the fossiliferous (*Semionotus* and *Estheria*), bituminous schists of Rhætic age outcropping in the south part of the hill of Cacheuta.

The various private companies who obtained oil concessions during the years 1886–1921 drilled only in this part. In 1930, when Y.P.F. started work in the area, the only districts known to be petroliferous were Cacheuta and Sosneado, and new data indicated that it was necessary to search for structures more favourable to oil accumulation than those existing at Cacheuta.

In March 1933, Stappenbeck discovered an asymmetric anticline, marked by Tertiary beds, in the Lunlunta hills, S.E. of Luján de Cuyo. The structure was considered favourable to oil accumulation, although it was realized that a considerable thickness of Tertiary, and possibly of Cretaceous beds would have to be penetrated before reaching the Cacheuta petroliferous horizon presumably underlying this structure.

The general trend of the Lunlunta anticline is N.W.–S.E. The W. flank dips up to 12° and the E. flank up to 75°. A system of apparently deep-seated strike faults is observable, one of which has been traced over 6 km.

The stratigraphic column of the Jujuy strata, exposed at Cacheuta, differs con-

siderably in thicknesses and lithologic character from that of Tupungato-Pilqna. According to Maraggi, the Cacheuta column is as follows :—

Conglomeratic Series. 300 m. +. Coarse and medium conglomerates, cemented with ashy and argillaceous sands. These beds occur on the anticlinal flanks and in tectonic hollows.

Transitional Series. 200 m. Conglomerates with medium and fine beds and intercalations of bay-coloured, argillaceous sand containing hard nodules of ashy sand. The upper part of the series contains tufaceous sandstones with plant remains. This series outcrops on the anticlinal flanks and in tectonic hollows.

Bay Series. 300 m. Bay-coloured sands, occasionally argillaceous, are predominant. Beds of volcanic debris and grey, ashy sands, with fine conglomerate intercalations, also occur. The series outcrops up the anticlinal flanks and on secondary folds.

Old Series. 150 m. Fine, yellow-bay sands, with intercalations of coarse sand and fine conglomerate. This series outcrops on the anticlinal cores.

Well No. 1 was drilled for water on the Lunlunta structure. It was carried down to a depth of 200 m., four water-bearing horizons being encountered at 70–76 m., 116–117 m., 138–139 m., and 189–191 m., respectively. The tested yield at 138 m. was 6000 litres per hour, and at 189 m. it was 10,000 litres per hour of slightly mineralized but potable water. Analyses show a mineral content of 1·14 grms. (dried at 115° C.) and 0·73 grm. (105° C.) per litre, respectively.

Well No. 2 was to test for oil, and was carried down to 2472 m. It bottomed the Jujuy beds at 570 m., reached the Cretaceous at 2165 m., and entered the Rhætic at 2305 m.

The Cretaceous beds consist of purple and green clays passing into red sands with frequent veins of anhydrite. In this well, Rhætic, bituminous schists, probably remnants of a displaced fault block, were encountered between 2179 and 2189 m.

The Rhætic beds, in their upper part, are composed of very micaceous, polychromatic clays and sands with occasional bands of anhydrite. From 2390 m. downwards very compact, fossiliferous, dark grey and black, bituminous shales, with thin breaks of grey bentonites and sideritic marls and clays, are encountered. Carbonized plant remains occur from 2390 m. to 2412 m., below which fish scales and *Estheria* casts are common, the latter being particularly abundant from 2430 to 2432 m.

Lunlunta No. 2 Well is the deepest drilled to date within the Argentine Republic. Its importance lies in the proof of the existence of Rhætic strata at Lunlunta at a depth not commercially prohibitive if oil is found in quantity.

Tests of water production and analyses are given for this well.

The light and heavy minerals separated from the strata penetrated are catalogued, and a description of the fossils found (with particular reference to *Estheria*) is included.

The paper is illustrated by a map and 7 plates and ends with a bibliography of 21 items. L. O.

9. New Fields in Roumania. I. Basgan. *Ann. Min. Roumanie*, Oct. 1937, **20**, 393–400.—In 1936 the crude oil production of Roumania was 8,407,000 m. tons. Owing to the rapid exploitation of present fields, this entails the constant discovery of new ones and deeper exploitation.

Possible petroliferous provinces exist in the Transylvanian Basin, Maramuresh region, Wallachian Plateau, the Oltenić Southern Carpathian region and the extension of the Moineşti structure.

Recently two new fields were discovered, Bucşani and Margineni-Olari, which is still being explored. At Margineni a complete and regular section is encountered. Production is from the Meotic, where varying qualities of oil are encountered in different sands. In one sand a very light oil (sp. gr. 0·680–0·696) is found at 180 atm. pressure, whilst in a slightly deeper sand an oil (0·815–0·850) is produced at 130 atm. The light oil is produced by several wells in small quantities, whilst the heavier oil is more abundant. The author explains the light oil by distillation due to high temperatures and pressures associated with tectonics and filtration by the marly sediments encountered in upward migration. So far about 6–10 sq. km. have been proved by drilling, but production has been rather disappointing. Information on drilling is given and the paper is illustrated by several maps and sections.

R. O. Y.

10. First Venezuelan Geological Congress. *Bol. Geol. y Mineria (Venezuela)*, April, July and Oct., 1937, **1**.—The first geological congress of Venezuela was convened by the Minister of Public Works and organized by the Technical Service of Geology and Mining of that Ministry. The congress was held at Caracas from February 15th to 22nd, 1937.

The volume is indexed, and includes a geological map of Northern Venezuela on a scale of approx. 1 : 1,800,000. The following papers were presented :—

Geological Observations in the Central Section of the Coastal Cordillera of Venezuela. S. E. Aguerrevere and G. Zuloaga. *Ibid.*, 1–22.—Publications dealing with the region consist of very generalized data, such as those of Humboldt, or cover restricted areas. The present work is essentially a reconnaissance, and gaps inevitably occur. Fortunately, however, correlation of certain strata over long distances has been possible, and it is hoped that the work accomplished will serve as a basis for future more detailed studies.

The coastal cordillera rises very rapidly, attaining a height of 2765 m. at Pico de Naiguatá, only 7800 m. from the coast. Its core has augen gneiss as a predominant constituent. The overlying metamorphics and sedimentaries are divided into three series : San Juan de Los Moros (Eocene), Villa de Cura (doubtful Mesozoic) and Caracas. The lithological and other resemblances of the Caracas series to the Cretaceous east of Lake Maracaibo (described by Hedberg and Sass) are so striking that a tentative correlation is suggested.

The paper is illustrated by 10 photographs, a generalized stratigraphical column and a map.

Contribution to the Geology of the Venezuelan Andes. V. Oppenheim. *Ibid.*, 25–45.—This paper deals with the results of a rapid examination of the Andine region from Barinas through Mérida and El Vigía to Carora along the Transandine highway, and treats especially the Palæozoic complex, particularly the older metamorphic and semi-metamorphic components.

A general description of the Venezuelan Andes is given, and the presence of terraces, now as much as 2000 m. above sea level, is noted. This is taken as proof of epeirogenic movements. Evidence of formerly widespread glaciation occurs.

The various outcropping series are described, and a tentative stratigraphical column, ranging from upper Algonquian to middle Ordovician, and representing an estimated thickness of 6000 m., is included. The upper Palæozoic and post-Palæozoic outcrops are dealt with, and the results are summarized in a column embracing Upper Carboniferous to Cretaceous beds.

A brief outline of the tectonics, and a bibliography of five items, conclude the paper, which is illustrated by a section extending from El Vigía (in the Maracaibo basin) to Santa Barbara (Orinoco flats).

Observations on the Cretaceous and Precretaceous Strata in Southwest and Central Venezuela. L. Kehrer. *Ibid.*, 49–75.—The only sound basis for stratigraphy is detailed palæontological knowledge, and this fact is well exemplified in the region under review, where physically similar Eocene and Cretaceous sandstones have repeatedly been confused.

The strata outcropping in the vicinities of Colon (Tachira), San Simon-Zea (Mérida), Rio Buenavista (Trujillo) and in the State of Lara are described and correlated. The columns are illustrated by four plates on a scale of 1 : 25,000.

In the N.E. and E. of Lara the Cretaceous sediments have been considerably altered by regional metamorphism. Limestones are marmorized, clays and marls become sericite shales, sandy quartzites change to sericite quartzites and carbonaceous strata to graphitic schists. The transition between normal and metamorphosed sediments is gradual.

Fossil evidence indicates that the whole of the North Range of Trinidad is of Upper Cretaceous age. As this range represents the continuation of the Venezuelan Coastal Cordillera, the assumption that the latter also contains beds of Cretaceous age is justified, in spite of the lack of fossils. Cretaceous beds are found also in the Interandine zone of Venezuela and south of the Andes.

The paper is illustrated by four photographs and a map of Northern Venezuela. It concludes with a bibliography of 30 items.

Synopsis of the Geological Formations West of the Maracaibo Basin. H. D. Hedberg and L. C. Sass. *Ibid.*, 77–120.—In spite of twenty years of geological studies, the

stratigraphical nomenclature employed by the several oil companies is by no means standardized, and the limits of the various stratigraphical divisions are differently interpreted. The object of this paper is to suggest a nomenclature which will serve as a basis for general adoption.

The various formations encountered in the Mara District, the Mountain Front and the Plains of Perija, and the western shore of Lake Maracaibo are described, and the history of their nomenclature is given. The conclusions reached by the author are summarized on a plate on which the four local stratigraphic columns are correlated.

The Palæozoic and early Mesozoic history of sedimentation and structural development of the region is obscure. From the inception of the great Andine geosyncline, however, in early Cretaceous times, the record is more complete.

The thick basal beds of coarse conglomerate are evidently the product of rapid erosion and deposit under shallow marine conditions. By middle Cretaceous times the topographic relief was considerably reduced, and the Cogollo formation was deposited in a moderately deep sea to which little detrital matter was carried. Maximum depth was attained probably at the beginning of the Upper Cretaceous, but the special palæogeographic conditions were unfavourable to bentonic life, and resulted in the tranquil deposition of the carbonaceous and bituminous foraminiferal limestones of the La Luna formation, followed by that of the laminated Colón shales.

The period from the end of the Cretaceous to the beginning of the Tertiary is marked by a fairly general emergence, although discordance between the Cretaceous and Tertiary is often lacking. In the geosynclinal troughs, however, marine conditions persisted during the Eocene. The end of the Cretaceous is marked by intercalation of marine and continental beds, and the Cretaceous–Eocene boundary is difficult or impossible to define exactly in these trough areas.

The Guasare formation represents a brief return to Paleocene deep-sea conditions.

With the retreat of the sea, the Maracaibo depression became the main locus of brackish and, rarely, marine sedimentation. Thus were formed the thick sands with numerous coal-beds of the Eocene.

In Oligocene–Miocene times, the sinking and elevation were erratic, and the same formations are marine or non-marine in different localities. At least 3000 m. of strata, chiefly non-marine, were deposited in the west part of the Maracaibo depression during Oligocene, Miocene and Lower Pliocene times.

The paper includes a map and a bibliography of 11 items.

Notes on the Stratigraphy of the Lake-side Fields of Bolívar, in the Maracaibo Basin, Venezuela. M. W. Haas and R. G. Hubman. *Ibid.*, 123–164.—The paper is divided into two sections, dealing respectively with post-Eocene and Eocene sediments.

Recent sediments consist of silts, fine sands and animal and vegetal remains. In favourable circumstances they may attain a thickness of 75 ft. in some parts of Maracaibo Lake.

Pleistocene–Pliocene deposits include consolidated, massive sandy clays, coarse sands and pebble beds of continental origin. Their thickness varies between 200 and 2500 ft.

The Miocene has two generally accepted divisions—La Puerta and La Rosa—but the application of these terms varies to some extent in different fields. A description of the several formations, with lists of contained macro and micro fossils, is given, together with a table correlating the nomenclature employed by the various operating companies.

The Oligocene is represented by the Icotea formation, which has a maximum thickness of 600 ft. It does not possess an original fauna.

The Eocene is divided into four main zones as a result of heavy residue determinations. The relations existing between the heavy mineral and lithologic zones are indicated, and the lateral and vertical variation in the mineral content is outlined. Lists and descriptions of the mineral grains recognized, together with their habitat, are given.

The possible sources of derivation, and the conditions under which deposition occurred, are discussed. Three plates, indicating possible geological histories, are included.

Zone A is distinguished by the presence of titanite; zone B is poor in other than authigenic heavy minerals; zone C is marked by suites of mineral grains which were formerly considered as characteristic of the whole of the Eocene. A distinctive variety of garnet (with few dodecahedra) and the presence of staurolite mark this

zone. The bottom zone, D, is marked by the etched character of its garnets, most of which show perfectly developed dodecahedral faces.

The author believes that heavy mineral determinations have a real value for correlative purposes in this area, and that the study might advantageously be extended to the outlying districts.

Stratigraphy and Palaeontology of Mene Grande and District. G. E. Tash. *Ibid.*, 167–180.—The stratigraphical divisions in current use, with the exception of those of the Upper Tertiary, were established by the pioneer field geologists. The palæontological divisions are founded, in their entirety, on the foraminifera recovered from well samples. No radical change is suggested in the current nomenclature, but it is proposed to adjust some of the terms "formation," "series," etc., to bring them more into accord with International usage. The stratigraphical column at Mene Grande would thus possess the following divisions: Quaternary Series; Upper Tertiary Series; Maracaibo Group; Eocene Series; Mene Grande Formation; Paují Formation; Misoa-Trujillo Formation (Upper and Lower Members).

The various divisions are described lithologically and palæontologically, and the history of their nomenclature is discussed.

The Paují formation was considered originally to be of Oligocene age, but later opinion places it in the Eocene. Van de Vlerk, on foraminiferal evidence, limits the whole of the Eocene beds of Mene Grande, including the lower member of the Misoa-Trujillo formation, to the Upper Eocene. L. O.

Geophysics.

11. Manual on Geophysical Prospecting with the Magnetometer. J. W. Joyce. *U.S. Bureau of Mines*, March 1937.—After a short discussion on the characteristics of magnetic fields, the magnetometer (both vertical and horizontal models) is considered in more detail. The theory is given on which the design of these instruments is based and the factors influencing sensitivity analysed. A high degree of sensitivity is usually not required, since interfering effects would tend to mask any small anomalies being measured. The latest patent Schmidt magnetometer has a sensitivity of 10 gamma per scale division. The construction of the horizontal and vertical Schmidt instruments is described and also that of the latest pattern, which has a round case to allow the use of either a vertical or horizontal magnet. The importance of temperature changes as affecting accuracy is emphasized, and it is pointed out that the new temperature compensated magnet system in which the aluminium spacer block is replaced by a light cobalt-steel frame, dispenses with the necessity of making temperature corrections. The effect of changes in the position of the centre of gravity of the magnet system and the shape of the knife edges is also discussed. Errors in orientation, levelling, and in the optical system are further sources of inaccuracy.

Corrections to magnetometer observations should include temperature, diurnal correction, latitude and longitude correction, auxiliary magnet correction, and base station correction, whilst, in the case of the horizontal magnetometer, a vertical intensity correction should also be applied. The weight given to these corrections depends on the magnitude of the anomaly being measured. When this is small, the accuracy of the survey depends on the accuracy of the corrections applied to the observed values.

Practical advice is given for the handling, use, and adjustment of instruments and for carrying out surveys. Methods for determining instrument constants are described in some detail, and finally some consideration is given to the interpretation of surveys. It is emphasized that interpretations must be geologically sound. S. E. C.

12. Supervision of Deep Borings. C. Mainka. *Beitr. Geophys.*, 1937, **7** (1), 49–52.—A brief description is given of a method for surveying boreholes. The elastic waves due to the hammering of the drilling bit, and possibly also to the scraping of the bit, are picked up at the surface by special detectors. The position of the bottom of the hole can then be determined. Such a method involves no interruption in drilling, and thus careful watch may be kept on the course of the borehole without inconvenience. The possibility of causing small explosions on the bottom of very deep holes in order to get appreciable surface effects is mentioned. S. E. C.

Drilling.

13. Efficient Drilling-in Rig Front Designed for Portability. V. B. Dallas. *Petrol. Engr.*, Nov. 1937, **9** (2), 51.—The construction of drilling-in rig fronts for the Mid-Continent indicates trend toward combination units for drilling-in wells and for taking pumping potentials.

Maximum portability is aimed at in the design and one of the latest designs can be moved any distance by two five-ton trucks with only the walking beam and the bull hoists dismantled. Work can be commenced within 6 hours after the main base is skidded on to a timber foundation. Dismantling requires only 4 hours.

A full description of the rig is given. L. V. W. C.

14. Damping Rotary Rig Ground Vibration. C. C. Lynde. *Petrol. Engr.*, Nov. 1937, **9** (2), 55.—Pronounced vibration of the ground, especially when the draw-works was being run rapidly, as when pulling cores, was noticed while drilling a projected wild cat on the Gulf Coast.

No notice was taken until a steam line on No. 2 boiler cracked, but then the operator commenced investigations.

The operator believed that these disturbances were largely, if not wholly, surface manifestations. A ditch was dug across the lease, directly between the rig and boiler setting, perpendicular to a line joining them and about 80 ft. from the well itself. A wall of hay was built up in the hole and scrap pipe was piled across to prevent the hay from floating out of the trench.

No further subsidence around the boiler settings was noticed.

The experiences of this operator indicate that deep drilling is not to blame for most of the destructive vibration noted in congested areas. Instead the tremble originates in and is transmitted by the rapidly-rotating portions of the draw-works.

L. V. W. C.

15. Patents on Drilling. O. A. Brown. U.S.P. 2,097,547, 2.11.37. Casing cutter.

C. C. Brown. U.S.P. 2,097,755, 2.11.37. A device for setting pipe in wells.

W. L. Church. U.S.P. 2,098,332, 9.11.37. Overshot.

H. B. Webster. U.S.P. 2,098,476, 9.11.37. An inclination direction indicator.

W. L. Forster and J. J. Santiago. U.S.P. 2,098,491, 9.11.37. Rotary jar.

F. L. Pivoto. U.S.P. 2,098,518, 9.11.37. Wire line swivel.

E. Burns and H. P. Wickersham. U.S.P. 2,099,048, 16.11.37. A setting tool for releasably connecting a string with an object to be set in a well.

C. A. Reinhard. U.S.P. 2,099,372, 16.11.37. Means and method of determining the inclination of wells by means of an elongated body having rigid ends but flexibly connected in the centre to allow lateral movement of the ends. Means for indicating inclination.

G. R. Trimslada. U.S.P. 2,099,779, 23.11.37. Suspension hydraulic swivel and feed for rotary drilling.

L. F. Bonney. U.S.P. 2,099,794, 23.11.37. Orienting device for well tools.

G. A. Macready. U.S.P. 2,099,859, 23.11.37. Collapsible rotary cone drill.

S. F. Westall. U.S.P. 2,099,877, 23.11.37. Piston bailer. L. V. W. C.

Production.

16. Hydraulic Pressure Actuated Bottom-hole Pumping Unit. F. B. Taylor. *Oil Wkly.*, 15.11.37, **87** (10), 23.—The problem of lifting large volumes of fluid from below 6000 ft. in the Mansion Area of Oklahoma City field has resulted in a variety of production methods being adopted.

An hydraulic pressure system is being used on one lease and has proved entirely satisfactory in operation.

The equipment in use with this system varies only slightly from the regular tubed producer. Three-inch upset tubing is run into the casing and into the tubing the hydraulic pump lift is run. Pressure is introduced into the pump through 1¼-in. hydraulic tubing capable of withstanding more than 5000 lbs. per sq. in. pressure. This smaller tubing is connected to the top of the lowered pump unit, the pump being actuated by means of the introduced oil-hydraulic power.

The surface equipment consists of filters, hydraulic pumps, heaters and powers. The take-off for supplying the pressure pumps is directly from the separator.

L. V. W. C.

17. Screen Openings and Unconsolidated Sands. Part I. C. J. Coberly. *Oil Wkly.*, 15.11.37, **87** (10), 39; *Petrol. Eng.*, Nov. 1937, **9** (2), 96.—The function of screen pipe is to permit free entry of oil with the exclusion of sand, and to perform this function properly the screen opening, regardless of type, must bear a definite relation to the grain-size of the sand.

Experiments show that a stable bridge is established when the width of a rectangular slot is twice the grain size or when the diameter of a circular opening is three times the grain size. No bridge will form when the openings exceed these values by approximately 25%.

Angular grains will form a stable bridge under the same conditions as spherical grains, but, due to the angularity of the grains, the point at which the bridge ceases is approximately 50% in excess of these values.

When a mixture containing two sizes is used, the bridging influence of the larger grain is great in relation to the amount present.

Unconsolidated oil sands will form stable bridges if the opening in the screen which retains 10% of the sample is taken as the diameter of the bridging grain and the rules for uniform spherical grains are applied.

Methods and apparatus used for making these determinations are discussed.

L. V. W. C.

18. Screen Openings for Unconsolidated Sands. Part II. C. J. Coberly. *Oil Wkly.*, 22.11.37, **87** (11), 34; *Petrol. Eng.*, Nov. 1937, **9** (2), 96.—The angle of repose of sand cannot be relied on to produce bridging if the sand is saturated with fluid. Hence the position of the slots does not affect bridging. Clogging of the screen openings is avoided by undercutting in excess of 2 degrees included angle, and it is desirable to avoid close spacing of slots.

The widest stable slot for broken consolidated formations can be determined from boiler samples, but cannot be relied on because of the possible effect of water or producing conditions on the cemented grains. The widest stable slot for well-consolidated sands cannot be determined by the methods suggested in the article.

The methods adopted in the experiments are given. L. V. W. C.

19. Gas–Oil Ratio Control in Flowing Wells. Part I. R. J. Sullivan. *Oil Wkly.*, 15.11.37, **87** (10), 28; *Petrol. Engr.*, Nov. 1937, **9** (2), 82.—Gas–oil ratio control is a problem of coping with free gas, and therefore of attempting to retain free gas in the formation while satisfactory volumes of oil are extracted. Control of differential pressures responsible for delivering oil and gas to the well is therefore necessary.

Well characteristics referring gas–oil ratio to production rate are presented from several gas-drive pools. A discussion of their behaviour in the face of gas-cap encroachment is given, and this is seen to be reflective of pool behaviour.

Conclusions reached from open-hole behaviour corroborate the studies of well behaviour after application of a positive gas shut-off to the sand face while illustrating

the possibilities of intermittent flow. They also strongly suggest the future contingencies to be considered by preventive methods of ratio control. L. V. W. C.

20. Gas–Oil Ratio Control in Flowing Wells. Part II. R. J. Sullivan. *Oil Wkly.*, 22.11.37, **87** (11), 27; *Petrol. Engr.*, Nov. 1937, **9** (2), 82.—Conclusions have been reached concerning the gas–oil ratio control in flowing wells and may be summarized as follows :

Wells presenting a gas-control problem respond to proper testing by yielding a variety of gas–oil ratios as the rate of production is varied.

A standard of pool efficiency over protracted periods gives a guide to the most desirable production rate.

All control methods must be reduced to a differential-flow pressure adjustment.

The gas–oil ratio control question is primarily one of preventing withdrawal of free gas from the formation. Gaseous formations should be shut off at the face mechanically when other differential regulation methods have been exhausted. Stop-cocking may also prove helpful.

Continued gas-cap expansion normally influences the permanence of any successful control method and should, therefore, be undertaken with an appreciation of future contingencies. L. V. W. C.

21. Individual Well Studies Result in More Efficient Pumping. M. A. Wright. *Petrol. Engr.*, Nov. 1937, **9** (2), 41.—Analysis of individual pumping problems is facilitated by a correlation of physical data with operating conditions.

Surface dynamometer cards do not give a true picture of bottom-hole pump operation, but certain characteristics in them that are indicative of the pump performance are possible of detection. Pounding can be recognized on the card by the fact that the rods do not immediately lose their load as the down stroke begins. It is caused by the barrel failing to fill completely with fluid. To evaluate the importance of standing valve design a series of flow tests has been carried out and the results are given in a graph.

Overstressing of sucker rods is a profitable source of trouble and rod strings should be studied for each well. A series of dynamometer cards is given for various wells in the Seminole Pool for different sized pumps. L. V. W. C.

22. Present Salt-Water Separation and Disposal Methods Used in East Texas Field. M. J. Goodnight. *Petrol. Engr.*, Nov. 1937, **9** (2), 65.—Separating the water from the oil in the East Texas Field is not difficult, as the greater portion of it drops out in the primary water separators. Heat is required in some cases, with compounds to accelerate settling, for stripping the water from the oil so as to produce pipe-line oil.

Devices for separating oil and water as they are pumped from the well have been constructed. These are placed between the tubing head and the separators.

Surface evaporation is being used considerably to dispose of large volumes of water produced along the west edge of this field. L. V. W. C.

23. Wild Well Defies Control. W. Blake. *Petrol. Engr.*, Nov. 1937, **9** (2), 80.—The Texan Drilling Company's well in the Agua Dulce field has defied all efforts to control it for a year. This well fired on November 19th, 1936, and for six months the company spent thousands of dollars on every known method of control in an attempt to harness the tremendous gas pressures. The wild well now consists of two craters, approximately 650 ft. apart, and the main crater is on fire, burning considerable oil and gas.

About 90 acres of land is encircled by a dyke, all of which is flooded and built up by mud from the two craters.

A relief well was drilled, shortly after the well fired, about 800 ft. away from the crater and 5000 brls. of heavy mud were pumped through the relief well into the sand without success. Clear water at the rate of 350 brls. an hour under a maximum pressure of 2200 lb. per sq. in. was then tried, but still without obtaining control.

The well is still burning strongly, and there appears to be no way of subduing it. L. V. W. C.

24. Patents on Production. J. R. Polston. U.S.P. 2,098,014, 2.11.37. A unitary valve for pipe-line systems.

W. L. Brundred and R. B. Bossler. U.S.P. 2,098,484, 9.11.37. Well packer.

J. Grant. U.S.P. 2,098,494, 9.11.37. Apparatus for cleaning wells comprising a low-pressure chamber and explosive means for opening this chamber to the well.

J. J. Santiago. U.S.P. 2,098,520, 9.11.37. Well-cleaning device.

J. W. Rowler. U.S.P. 2,099,080, 16.11.37. Bottom-hole well sampler.

W. H. Hunter. U.S.P. 2,099,691, 23.11.37. Spiral packed working barrel valve body. L. V. W. C.

Gas.

25. Precision Combustion Analysis of Gases. E. H. Boomer and C. A. Johnson. *Canad. J. Resh.*, Sept. 1937, **15**, 363.—The method has been designed for the quantitative analysis of gases composed substantially of methane containing small amounts of hydrocarbon vapours. The apparatus employed consists essentially of a method of rapidly re-circulating the gas mixed with air or oxygen through an electrically heated combustion tube containing copper oxide plus 1% of cerium oxide. An analysis on 200 c.c. of gas may be completed in approximately 2 hrs. J. W. H.

26. Patents on Gas. Zahn and Co., G.m.b.H. E.P. 473,248, 8.10.37. Recovering sulphur from gases containing H_2S by burning H_2S to S and steam with oxygen or air at 200° C. in a small reaction chamber in the presence of a catalyst, *e.g.* bauxite, titanic acid, iron ore, etc.

I.G. Farbenindustrie, A.-G. E. P. 473,932, 22.10.37. Conversion of CO and H_2 into liquid, solid and/or gaseous hydrocarbons or their derivatives containing oxygen. Iron and aluminium hydroxides are used as catalysts.

Vergasungs Industrie, A.-G. E.P. 473,948, 22.10.37. Process and apparatus for producing water-gas free from tar and hydrocarbons from bituminous fuels.

Electroflo Meters Co. E.P. 473,969, 22.10.37. Instrument for analysing and measuring constituents of a gas.

W. J. Tennant. E.P. 474,414, 1.11.37. Separation of ethylene from higher olefines by passing such gases into benzene in the presence of aluminium chloride at 50° C. and separating the residual ethylenic gas from the liquid reaction product of the benzene compound with higher olefines.

G. W. Johnson. E.P. 474,649, 4.11.37. Apparatus for degasifying alkaline liquids laden with H_2S.

G. W. Johnson. E.P. 474,448, 26.10.37. Conversion of Co and H_2 into gaseous, solid or liquid hydrocarbons, using a specially prepared iron oxide catalyst. W. S. E. C.

Crude Petroleum.

27. Commercial Processes used in Reducing Salt Content of Crude Oils. G. Egloff, E. F. Nelson, C. D. Maxutov and C. Wirth. *Oil Gas J.*, 21.10.37, **36** (23), 66.—The method in general use for the desalting of crudes consists of dispersion of fresh water in the oil in fine particles, so that they will coalesce with the brine droplets, and of breaking the emulsion so formed with chemicals. Dehydration of the salty crude direct is extremely difficult, owing to the fineness of the particles. The chemical demulsifier is for preference added to the water rather than to the oil, so as to bring it near the water–oil interface of the droplets. In some cases, however, the most effective chemical is not dispersible in water, and must be added to the oil. The main essentials for thorough desalting are: (1) fine and uniform dispersion of the added water, (2) high settling tank temperature and (3) careful selection of the demulsifying chemical.

A further method in general use is electrical dehydration of the salty crude emulsified with added fresh water, using *e.g.* A.C. current of 16,000–33,000 volts potential. Emulsification is effected with turbulent flow of oil and water, orifice plate mixers, centrifugal pumps or back-pressure valves. In a desalting unit handling an Urbana (Ark.) crude, 5–20% of wash water is added to the oil and the emulsion electrically dehydrated at 130–200° F., the salt being reduced from 200 lb. per 1000 brl. to 8 lb. and the water content to 0·7% or less. This treatment has resulted in increasing the length of tube still runs from 3–6 days before plugging with salt occurred to 60–70 days, in addition to reducing the corrosion of equipment to a considerable extent. Similar results are quoted from various refineries using this system. The cost of the process is reported as 0·75–1·1 cents per brl.

From an examination of the behaviour of salty crude on centrifuging, it is suggested that salt appears in three different forms: (1) as brine emulsified in the oil, (2) as crystalline salt, removable by centrifuging, and (3) as crystalline salt only slightly removable by centrifuging. These probably differ in crystal size or colloidal form, and in the nature of the hydrocarbon film surrounding the crystals. By using the correct degree of agitation with fresh water at the necessary high temperature, almost complete desalting by centrifuge can be obtained.

Laboratory work has also indicated that filtration, preferably with filter aid, will also reduce the salt content to a considerable extent. C. L. G.

Cracking.

28. Cracking Three Different Charge Stocks in a Combination Selective Cracking Unit. E. R. Smoley, A. H. Schutte, W. Ullrich and H. M. Curtis. *Nat. Petrol. News*, 20.10.37, **44** (42), R. 250.—Plant data, when operating on various crudes, demonstrate the results obtained in actual refining practice when applying the principles of combination selective cracking. The principles are discussed briefly and illustrated by flow diagrams. Details of the heater design and plant photographs are given. Van Zandt crude yielded 62% gasoline, 29% fuel oil and 9% gas and loss. East Texas Crude yielded 55·5% gasoline, 8·5% Stoddard solvent, 8·1% kerosine, 23·2% fuel oil and 4·7% gas and loss. Mixed Gulf Coast crude yielded 64·7% gasoline, 23·8% fuel oil, 11·5% gas and loss. The straight gasoline yields of these crudes were 20%, 34% and 15% respectively. H. G.

29. Patents on Cracking. H. B. Sharp. U.S.P. 2,094,724, 5.10.37. Improved heater for cracking plants.

J. D. Seguy. U.S.P. 2,094,907, 5.10.37. Refining of cracked spirit containing olefinic hydrocarbons to produce high anti-knock motor-fuel. The olefinic hydrocarbons are polymerized and the product is hydrogenated with the hydrogen formed during the pyrolytic cracking.

M. W. Barnes. U.S.P. 2,094,911–2,094,912, 5.10.37. Improved cracking furnace.

D. M. Evans. U.S.P. 2,094,980, 5.10.37. Cracking of hydrocarbons—preferably in the vapour phase—by means of hot gas constituted in substantial part at least by the exhaust of an internal-combustion engine at temperatures above 950° F. The gas is mixed with the vapour of the oil to be cracked.

E. B. McConnell. U.S.P. 2,095,418, 12.10.37. Method of flash-distilling petroleum.

O. Behimer. U.S.P. 2,095,963, 19.10.37. Process for distilling pressure tar.

J. D. Seguy. U.S.P. 2,096,204, 19.10.37. Cracking and subsequent hydrogenation of hydrocarbon oils. W. S. E. C.

Hydrogenation.

30. Patents on Hydrogenation. G. W. Johnson. E.P. 473,082, 6.10.37. Destructive hydrogenation catalyst consisting of a coky carrier impregnated with zinc chloride or phosphoric acid. W. S. E. C.

Polymerization.

31. Catalytic Polymerization of Butylenes by Sulphuric Acid. S. H. McAllister. (A.P.I. meeting, Chicago, 1937). *Oil Gas J.*, 12.11.37, **36** (26), 139; *Refiner*, 1937, **16** (11), 493.—A description is given of the cold sulphuric acid process and of the hot acid polymerization process in commercial use for the production of a 98–100 O.R. octane fuel from the C.4 fraction obtained from Dubbs cracked gases.

Cold Acid Process. A C.4 fraction consisting of 18·5% *iso*butylene and 28% normal butylenes is contacted with 60–70% H_2SO_4 at 20–35° C. countercurrently in two stages, 90% of the *iso*butylene being selectively absorbed. Stronger acid absorbs the *iso*butylene more completely, but will also absorb the butylenes. A high acid-alcohol ratio in the acid phase is maintained to assist complete absorption. Low temperatures increase the degree of absorption, but a temperature of 20–40° C. is maintained to obtain a high reaction rate without premature polymerization. The acid phase is passed to a polymerization unit consisting of coils heated to 100° C., the acid being returned to the absorption unit and the polymer washed and distilled. A yield of 78% di*iso*butylene is obtained with 68% acid, this being subsequently hydrogenated to *iso*-octane. This process gives a rather low yield of *iso*-octane (of, however, high purity), only 26·7% of the total olefines in a stock containing 46·8% olefines being converted.

Hot Acid Polymerization. By raising the temperature in the acid absorption process the absorbed *iso*butylene is polymerized, and passes to the hydrocarbon layer, so that the absorption reaction is catalysed to completion, and all the *iso*butylene recovered as polymer. In addition, the butylenes react with the acid in the presence of the *iso*butylene forming interpolymers, which on hydrogenation have octane ratings nearly equal to that of pure *iso*-octane. Also the transfer of the polymer as it is formed to the hydrocarbon phase dilutes it, thereby reducing its activity and the possibility of formation of trimers or rearrangement to polymers of lower octane rating. A yield of 88% of octenes of 99·2 O.R. is given by this process, as compared with 75% of octenes of 100 O.R. by the cold acid method.

Recovery of the hot acid polymer from the hydrocarbon layer is effected by a caustic wash to remove acid or acid sulphates, a flash tower to strip hydrocarbon gases and a high-temperature treater to remove sulphur.

No difficulties due to corrosion by sulphuric acid are experienced, whilst first cost and maintenance of the unit are low. The properties, including anti-knock blending octane values and lead susceptibilities of hot acid octane and technical *iso*-octane, are tabulated. C. L. G.

32. Motor Fuels from Polymerization. G. Egloff, J. C. Morrell, and E. F. Nelson. (A.P.I. Meeting, Chicago, 1937). *Oil Gas J.*, 2.11.37, **36** (26), 176; *Refiner*, 1937, **16** (11), 497.—It is estimated that the hydrocarbons available in the U.S. would produce more than 9,000,000,000 gls. of polymer gasoline, including over 1,000,000,000 gls. of *iso*-octane fuel of 95–100 O.R. Three modifications of the catalytic polymerization process, employing solid phosphoric acid, are described. These are: (1) polymerization of hydrocarbon gases containing propene and butene, (2) pyrolytic cracking of butanes and propane to produce olefines, followed by catalytic polymerization; and (3) selective polymerization of n. and *iso*butene and hydrogenation to *iso*-octane. A typical unit employing process (1) is described, producing 68,000 gls. of 82 O.N. fuel from 14 million cu. ft. of gas containing 25·4% propene and butenes. The gas is charged at 300 lb. pressure and 375–400° F. to the polymer unit, passed through catalyst towers, the polymer being passed with the residual gases to an absorption tower, and thence to a stabilizer and debutanizer, where the polymer is taken off as a side cut and the bottoms are re-circulated as absorption oil. The catalyst becomes covered with a carbonaceous deposit, and after 60 days use is regenerated by controlled oxidation and steam treatment. A production of about 50 gls. of polymer per lb. of catalyst is obtainable before the activity is reduced. In another commercial unit H_2S is removed from the cracked gases by absorption in tripotassium phosphate. A commercial butane cracking and catalytic polymerization unit described processes 1090 brl. a day of butane producing 293 brl. of polymer gasoline of 81 O.N. Butane is cracked at 750 lb. and 1065–1075° F., a 50% conversion being aimed at. After cooling to 90° F.,

the material is demethanized, debutanized, and the overhead gases are passed to the catalytic polymer plant.

The selective polymerization process utilizes the butane–butene fraction from the cracked gasoline stabilizer, which, after sulphur removal, is heated to 350° F. at 600 lb. and passed through the solid phosphoric acid catalyst. The polymer is stabilized and fractionated into dimers (*iso*-octenes) and trimers dodecenes), the former being hydrogenated. A commercial unit produces from 1300 brl. per day of B.B. fraction (in equal proportions), 347 brls. of *iso*-octenes.

Properties of the polymer gasolines from the different processes are tabulated, and their value as blending agents for aviation fuels is emphasized. C. L. G.

33. Patents on Polymerization. Ammonia Casale. E.P. 473,219, 8.10.37. Polymerization of acetylene by passing it over a catalyst of Au, Mo, Ag or their alloys or alloys containing Fe, Al, S , Cr or C at 300–800° C.

Standard Alcohol Co. E.P. 474,119, 26.10.37. Cracking and then polymerizing light hydrocarbons at 650–1000° F.

Houdry Process Co. E.P. 474,377, 29.10.37. Preparation of gases for polymerization. W. S. E. C.

Refining and Refinery Plant.

34. "Shell" Group's New British Plant. Anon. *Petrol. Times*, 30.10.37, **38** (981), 557.—A detailed, illustrated account of the new lubricating oil extraction and dewaxing plant at Shell Haven. L. O.

35. Anglo-American Oil Co.'s New Plant at Ellesmere Port. Anon. *Petrol. Times*, 14.12.37, **38** (986), 727.—A description of a new plant for the manufacture of special solvents and white spirits. L. O.

36. Influence of Silicon Additions on the High-Temperature Characteristics on 4–6% Chromium Molybdenum Steels. C. L. Clark and M. Fleischmann. *Nat. Petrol. News*, 3.11.37, **29** (44), R. 274.—Strength at elevated temperature is generally imparted to steel by the addition of carbide-forming elements such as Cr, Mo, Wo, V. Cr, Si and Al dissolve in the ferrite and impart oxidation and corrosion resistance. Si, especially in conjunction with Cr, greatly improves oxidation resistance. The article deals comprehensively with the properties of two steels of similar composition, apart from their Si content, which was 0·18 and 1·55% respectively. At room temperature the increase in Si content increased the tensile strength, yield strength and proportional limit in marked degree. At temperatures above 1000° F. the higher Si content produced a somewhat lower tensile strength, but yield stress did not suffer until 1400° F. was reached. Ductility was greatly increased at elevated temperatures by the higher Si content, which likewise greatly increased resistance to attack by hot gases at 1500° F. Creep strength at cracking still temperatures is improved by the increase in Si content. The high Si content steel showed greatly increased resistance to surface oxidation and inter-granular oxidation, the latter indicating greater structural stability. H. G.

37. Corrosion Rates of 10,000 Still Tubes Guide Selection of Steels. M. G. Van Voorhis. *Nat. Petrol. News*, 20.10.37, **29** (42), R. 242.—The systematic routine examination of cracking still tubes and the systematic recording of the results have been carried out over a number of years. Each tube is numbered, and its life history is recorded in the form of periodic measurements of its internal diameter. These measurements have been greatly facilitated by the use of an electrical device, which allows them to be made throughout the whole length of the tube and while the tube is in place. H. G.

38. Selection of Steel for High-Temperature Service. M. Fleischmann. *Oil Gas J.*, 21.10.37, **36** (23), 48; *Refiner*, 1937, **16** (12), 573.—In view of the lack of correlation of the data on the high-temperature behaviour of steels, a new testing procedure has been initiated, in which the specimens are stressed at various loads until rupture occurs. The loads are plotted on logarithmic co-

ordinates against time, straight lines being produced so that the laboratory data can be extrapolated to periods equivalent to the commercial life desired. In a discussion of the elongation of materials with time under constant stress, it is shown that creep first occurs at a decreasing rate, and finally at an increasing rate. Present creep tests seldom exceed 1000 hrs., but it is shown graphically that a stress of 22,000 lbs., which produces a creep rate of 0·10% after 1000 hours, resulted in a creep of 1% in 1000 hrs., after loading for 5000 hrs., thus leading to fracture in less than 10,000 hrs. From graphs it is established that there is a definite relationship between rupture strength and creep strength for a given temperature, so that the more economical rupture tests may be used to determine the properties of steels at high temperature.

Effect of Alloys on Creep Strength. Data on the effect of carbon content on the creep strength of steel containing 0·5% Mn indicates that up to 0·37% carbon increases the creep strength at low temperatures, but not at high, it being considered that the form of the carbides present is the controlling factor. Cr, Mo, W and Va increase the creep strength, there being an optimum percentage in each case. Si and Al lower the high-temperature creep strength, although increasing the scale and corrosion-resistance values. The heat treatment of the steel is of the greatest importance, it having been shown that a treatment giving coarse ferrite grains increases the creep strength, whilst complete spheroidization of the cementite lowers it.

Corrosion Resistance. Carbon, although increasing the hardenability of steels, increases the corrosion rate. With steels containing more than 3% Cr the corrosion resistance is proportional to the Cr content, the addition of Ni showing, however, no effect. Mo has little effect on the corrosion resistance of plain Cr steels, but may materially increase the resistance of the 18·8 austenitic Cr Ni steels, especially against H_2SO_4. Si and Al improve the corrosion resistance of Cr steels (*e.g.* a 5% Cr Mo steel containing Si and Al gave twice the corrosion resistance of 4–6 Cr Mo steel in oil-cracking tubes for refining sour crudes). Ti and Co in chromium steels form carbides, releasing Cr for the enrichment of the ferrite, and thereby give increased corrosion resistance, although their main value is in air-hardening.

Variations in microstructure do not materially affect the oil-corrosion resistance of steel at high temperatures, although full annealing generally gives best results. Cold working may reduce internal stresses affecting the corrosion resistance.

Oxidation Resistance. Laboratory data provide information of relative value only on the oxidation resistance in practice of steels. 10% of Cr is required to obtain non-scaling properties at 1300° F., 3% showing little improvement, whilst 4–7% showed marked benefit. Si and Al in combination with Cr show particularly marked oxidation resistance, a 5, 1·5 Cr Si steel being considered non-scaling at up to 1475° F. in air.

Toughness. It is emphasized that initial ductility at room temperature does not ensure satisfactory toughness after prolonged service at operating temperatures, rupture tests being recommended to provide this information. The 4–6% Cr Mo steels undergo intercrystalline oxidation at 1200° F., materially reducing the toughness, whereas the addition of 1·5% Si retains the ductility owing to the higher scale resistance. In the KA_2S steel carbide precipitation the resulting grain boundary attack lowers the toughness of the material, to such an extent that sudden failure under pressure may occur. Cr, Cr–Si and Cr–W steels are susceptible to temper embrittlement, but 0·5% Mo eliminates this effectively. The addition of Ti and Co to the 4–6 Cr steels to prevent air hardening is liable to promote grain growth and lower structural strength.

The refinery service records of various high-temperature commercial steels from the above aspects are tabulated and discussed. C. L. G.

39. Properties of Metals for Use in Low Temperature Processes. W. L. Nelson. *Oil Gas J.*, 21.10.37, **36** (23), 63.—For low-temperature uses, *e.g.* air transportation, dewaxing of petroleum, refrigeration and the handling of liquefied gases, carbon steels and low-percentage alloy steels are too brittle, owing to the presence of cementite (iron carbide). The most suitable metals are the alloys, which consist of solid solutions, *e.g.* Monel metal (Cu–Ni) and 18·8 Cr Ni steel. The embrittling effect of carbon is shown by a graph of Charpy impact values at different temperatures of carbon and nickel steels, the shock resistance decreasing with the percentage of carbon.

Improvement in shock resistance at low temperatures is shown to result from tempering at high temperatures to overcome the hardness and brittleness caused by quenching, which leaves the carbide particles in a finely divided state. The presence of soluble elements, *e.g.* Ni, Si and Cu, leads to the formation of materials similar to solid solution alloys, whereas Cr, W, Mo and Va tend to form brittle carbide particles unless extremely large percentages of the alloy are used or very small percentages of carbon. 4–6% Cr steel is particularly bad in this respect. C. L. G.

Chemistry and Physics of Petroleum.

40. Kinetics of the Oxidation and Inflammability of Hydrocarbons. M. Prettre. *Ann. Off. Combust. liq.*, 1937, **12**, 411–446.—A study has been made of the combustion of mixtures of normal pentane with oxygen and an inert gas (nitrogen or argon) at temperatures between 250° and 360° C., and pressures between 100 and 750 mm.

Below 300°, and at any pressure, the addition of an inert gas increases the speed of slow oxidation, and also aids the production of flame. In the initial period of acceleration, the speed, W, of the slow reaction as a function of the time, t, agrees with the law for processes with frequently branching chains. Thus,

$$W \propto A \cdot e^{\phi t} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where A is a constant, and

$$\phi = k \cdot P_c P_t^2 \left(1 + a\frac{P_i}{P_t}\right) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where a and k are constants, and P_c, P_t and P_i are respectively the partial pressures of the pentane vapour, the sum of the pressures of this vapour and the oxygen, and the pressure of the inert gas.

The production of flame, when it occurs, takes place in the time, τ, defined by the equation

$$\phi\tau = \text{constant} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

or even more rapidly than this expression would indicate. The delay therefore is much reduced when the pressure of the inert gas is raised. Argon is a better accelerator than nitrogen.

Given a sufficiently high pressure of pentane and oxygen, it is probable that the above law applies at all temperatures.

Above 300–320° and at pressures between 100 and 300 mm., the addition of the inert gas, however, has the effect of slowing up the oxidation and hindering the production of flame. Earlier work limits this conclusion to temperatures not over 450–500° C.

These results, added to those of earlier work, tend to show that unstable molecules, such as peroxides, play an important part in the propagation and branching of the chains in this combustion. W. E. J. B.

41. Isomeric 2-Pentenes. H. J. Lucas and A. N. Prater. *J. Amer. Chem. Soc.*, 1937, **59**, 1682–1686.—The isomeric *cis* and *trans*-2-pentenes have been synthesized from the pure *cis*- and *trans*-α-methyl-β-ethylacrylic acids. These hydrocarbons have identical boiling points—namely, 35·4 at 740 mm.—but different relative indices. The *cis*-form has a value of n_D^{20} 1·3817, whilst the *trans*-form gave 1·3799.

The authors have prepared pentenes from 2- and 3-pentanol and from 2- and 3-bromopentane. They conclude that the pentene prepared from the 3-bromopentane is the *trans*-isomer, whilst that from 2-bromopentane is considered to be a mixture of *cis*- and *trans*-2-pentene and -1-pentene. W. E. J. B.

42. Catalytic Isomerization of *n*-Butane and *iso*Butane. C. W. Montgomery, J. H. McAteer and N. W. Franke. *J. Amer. Chem. Soc.*, 1937, **59**, 1768–1789.—It has been found that in the case of the butanes a reversible isomerization takes place at low temperatures which is uncomplicated by cracking.

The reactions were carried out at room temperature in the liquid phase under the equilibrium vapour pressure of the butane mixture, *i.e.* about 3 atmospheres. Anhydrous aluminium bromide was found to be an effective catalyst, and was usually

employed in 5 mole % concentration. The equilibrium mixture of butanes in the liquid phase at room temperature consists of 78–82 mole % of *iso*butane and 18–22 mole % of *n*-butane.

The equilibrium has been approached from both sides, and experiments have been carried out on C.P. butanes separately, as well as on butane mixtures of known composition.

Apparently the reactions are quite slow, over two months being required to reach equilibrium at room temperature, starting with the pure compounds and 5 mole % of catalyst. W. E. J. B.

43. Vapour–Liquid Equilibria of Methyl*cyclo*hexane–Toluene Mixtures. D. Quiggle and M. R. Fenske. *J. Amer. Chem. Soc.*, 1937, **59**, 1829–1832.—Data are presented for mixtures of methyl*cyclo*hexane and toluene showing densities, refractive indices and boiling points.

It is concluded that such mixtures are suitable for testing, under total reflux, batch fractionating columns having not more than 20–30 theoretical plates. It is advisable to work in the range of 10–75 mole % methyl*cyclo*hexane (in the liquid). W. E. J. B.

44. Ratio of Substitution to Addition in Reaction of Chlorine with Olefins in Dilute Carbon Tetrachloride Solution. T. D. Stewart, K. Dod and G. Stenmark. *J. Amer. Chem. Soc.*, 1937, **59**, 1765–1766.—This note describes some preliminary experiments carried out with 1-pentene, 2-hexene, 1-, 2- and 3-heptene.

The identity of the substitution products has not been determined, as the chief interest was in the magnitude of the substitution reaction as it was affected by the concentration of the reagents.

In general, excess olefin increases substitution, and excess chlorine decreases substitution. This is superimposed upon an effect due to actual concentration. In the case of 1-pentene more dilute systems gave increased substitution, whereas with the heptenes just the opposite resulted.

It would appear that large differences in reactivity do not greatly affect the ratio of addition to substitution when the reactivity is fairly large, but there remains the fact that a very high percentage substitution is found in the case of the unusually reactive olefin. W. E. J. B.

45. Decade of Research on the Chemical Constituents of Petroleum. F. D. Rossini. *Oil Gas J.*, 12.11.37, **36** (26), 193; *Refiner*, 1937, **16** (11), 545.—The results are presented of a ten-year research programme on the chemical constitution of a Mid-Continent petroleum, carried out by the A.P.I. and the National Bureau of Standards, both the amounts present and the properties of individual hydrocarbons being determined. Details are given of the technique developed in the separation of hydrocarbons, this involving *distillation* (under varying pressure and azeotropic conditions), *crystallization* (simple refrigeration with equilibrium melting and refrigeration in an appropriate solvent), *extraction* (with different solvents and at different temperatures) and *adsorption*.

The procedure followed in analyzing the crude oil used (from Well No. 6, South Ponca field, Kay County, Oklahoma) is outlined. Of the gasoline fraction the following cuts were examined: 55–100° C., 100–130° C., 130–160° C. and 160–180° C., the higher-boiling fractions being stored for further work. In addition, a lubricating oil cut was separated, divided into extract, wax and water-white portion and examined. A list is given of the hydrocarbons found in the gasoline fraction with their boiling points, degrees of purity of best sample isolated and estimated relative amount present.

Over three-quarters of the 55–145° C. distillate has been assigned to 31 hydrocarbons, whilst 45 hydrocarbons have been isolated from the 55–180° C. distillate (24 paraffins, 11 naphthenes and 10 aromatics), about half of this fraction consisting of 12 hydrocarbons only. The examination of the lubricant fraction consisted of distilling, extracting and filtering the cuts to about 600 fractions "homogeneous" with respect to type and size of molecules. The chemical nature of the fractions separated was determined.

Details of the work in hand and further work being considered are given, and it is

emphasized that the value of the work lies not only in the obtaining of data which will help in the control and economy of processes used for broad fractionation, but also in providing knowledge of methods of obtaining individual hydrocarbons of great potential industrial value. C. L. G.

46. Separation of the Three Methyloctanes from Mid-Continent Petroleum. J. D. White and A. R. Glasgow, Jr. *Bur. Stand. J. Res.* (*Wash.*), 1937, **19** (4), 423–435.—The methyloctane fraction from an Oklahoma petroleum contains, besides *o*-xylene, not less than six hydrocarbons: two naphthenes and four isomeric nonanes. Separation into its constituents is not an easy task, and has required the judicious use of distillation, extraction, absorption and crystallization.

The paper describes the isolation of 2-, 3- and 4-methyloctane from this fraction.

The material was first freed from xylene by extraction with SO_2, fractionation under reduced pressure and filtration through silica gel. The fractions boiling between 100·8 and 102·0° C. at 215 mm. were systematically crystallized from solution in dichlorodifluoromethane to yield 2-methyloctane of b.p. 143·35° C. at 760 mm.

The distillate b.p. 143·6–144·4° C. at 760 mm. was first distilled with glacial acetic acid to remove naphthenic material. Systematic crystallization from solution in dichlorodifluoromethane of all material boiling above 144·1° C. yielded a hydrocarbon identified as 3-methyloctane and boiling at 144·18° C.

The material b.p. 141–143° C. was distilled at 215 mm. to remove lower-boiling naphthenes, and the fraction b.p. 142–143 obtained from this was distilled with acetic acid. Crystallization from solution in propane and methane yielded a sample containing 5·7 mole % naphthenes and 94·3% 4-methyloctane.

To establish the identity of the isolated substances, the physical properties of the best samples of each were compared with those reported for the corresponding synthetic compound. As a further test of purity their behaviour during cooling and warming was observed, and each hydrocarbon was examined for boiling point, freezing point, density, refractive index and "aniline point."

It was found that the crude oil contains 0·3% of methyloctanes, these being present in the proportion 3 (2-methyloctane), 1 (3-methyloctane) and 1 (4-methyloctane). D. L. S.

47. Vaporization Equilibrium Constants in a Crude Oil–Natural Gas System. D. L. Katz and K. H. Hachmuth. *Industr. Engng Chem.*, 1937, **29** (9), 1072.—The equilibrium constants for the components methane to hexane in a Mid-Continent crude oil were determined over a pressure range 15–3000 lb. per sq. in. and 40–200° F. The results demonstrate the rise in the equilibrium constants with pressure at high pressures. The smoothed data are presented graphically. The results show quantitatively the behaviour of those gases which produce a liquid phase upon *iso*thermal expansion from a high pressure. P. D.

48. Theory of the Elimination Curve. N. D. Embree. *Industr. Engng Chem.*, 1937, **29** (9), 975.—The elimination curve has been proposed by Hickman (*ibid.*, 1937, **29**, 9, 968) as a means of assay in molecular distillation. It is essentially a method of estimating the quantity and characteristics of small concentrations of definite substances in the distilland. The theoretical basis of such curves is considered in this paper. P. D.

Analysis and Testing.

49. Graphical Solutions of Viscosity Problems. J. Groff. *Monit. Petr. roum.*, 1937, **38** (20), 1543–1548.—Instead of the usual method of using cartesian co-ordinates to represent change of viscosity with temperature, the author employs the system of parallel co-ordinates, added to and modified in a comprehensive nomogram. As a result every oil has a distinctive so-called point of origin. The utility of this function for meeting specifications, for example, can readily be seen by noting whether or not it falls inside a quadrilateral, the sides of which are formed by the viscosity–temperature lines representing the viscosity limits specified. Also, since the points of origin for oils of the same Dean and Davis Viscosity Index lie on a common curve, it is possible to determine this function directly from a simple knowledge of viscosities

in any units at any two temperatures. The Ubbelohde Pole Height and Angular Index, as well as the French Air Ministry Absolute Index, can also be determined, as can the proportions of constituents in binary or tertiary mixtures to give required viscosities at any temperatures. Since Redwood, Saybolt, Engler and kinematic viscosities and Barbey fluidity scales are included, the interconversion of any of these is possible with the assistance for alignment purposes of plain scales in millimetres at either side of the viscosity scales. The incorporation of S.A.E. limits extends the range of usefulness of the nomogram. The method of using the nomogram is illustrated by a number of examples. J. L. T.

50. Drainage Error in Viscometry of Aqueous Solutions. G. Jones and R. E. Stauffer. *J. Amer. Chem. Soc.*, 1937, **59**, 1630–1633.—These authors consider the drainage error to be composed of two parts: (*a*) the "after-drainage" which will drain out of the measuring bulb during a protracted period following the passage of the meniscus, and (*b*) the "wetting-film" which remains on the inner surface even after this protracted drainage.

An apparatus is described for investigating the above points, in which water and other liquids can be arranged to flow from a measuring bulb under different heads, and therefore with different times of outflow.

The experiments showed that, for a given surface, the volume of the "after-drainage" multiplied by the time of outflow was constant, and that this constant was directly proportional to the kinematic viscosity of the liquid.

It can readily be shown that there would be no error in relative viscosity measurements due to "after-drainage."

As regards the "wetting-film" which remains after prolonged drainage, it was concluded that in comparing a 40% sucrose solution with water, the given viscometer would not show an error greater than about 0·08%. W. E. J. B.

51. Condensation of Vapours on a Horizontal Tube. E. M. Baker and A. C. Meuller. *Industr. Engng Chem.*, 1937, **29** (9), 1065.—The temperature variation around the perimeter of a tube on which pure and mixed vapours are condensing was investigated. The vapours were water, benzene and binary mixtures of water with benzene, toluene, heptane and trichlorethylene. The variation in temperature round the periphery was small when small temperature drops between tube wall and vapour were used, but large for moderate and large temperature drops. There is no point at which a correct mean temperature may be obtained.

The data obtained were used to calculate heat transfer coefficients, and this data and that of Kirkbride (*ibid.*, 1933, **25**, 1324) were correlated by means of the equation:—

$$h\left(\frac{\mu^2}{k^3_{av.}\rho^2_{av.}g}\right)^{\frac{1}{3}} = 1{\cdot}28\left(\frac{C_{pav.}\mu\rho^{0{\cdot}7}_{av.}}{k_{av.}\lambda_{av.}}\right)^{2{\cdot}38}\left(\frac{Q_s}{Q}\right)^{-3{\cdot}28}$$

h = heat transfer coefficient for mixture, B.T.U./(hr.) (°F) (sq. ft.).
Q_s = quantity of heat transferred by non-aqueous component B.T.U./hr.
Q = quantity of heat transferred by mixture B.T.U./hr.
k = thermal conductivity (B.T.U.) (ft.)/(hr.) (°F.) (sq. ft.).
g = acceleration due to gravity = $4{\cdot}18 \times 10^8$ ft./(hr.) (hr.).
C_p = specific heat B.T.U./(lb.) (°F.).
λ = latent heat of vaporization B.T.U./(lb.).
μ = viscosity of condensate lb./(ft.) (hr.).
ρ = density of condensate lb./cu. ft.

The viscosity μ was that of the component forming the film in the drop-film type of condensation. P. D.

52. Molecular Distillation: Apparatus and Methods. K. C. D. Hickman. *Industr. Engng Chem.*, 1937, **29** (9), 968.—A full description is given of a circulating molecular still, the main feature of which is the provision of two interconnected receivers for the residue, placed one vertically above the other. Residue is collected in the upper receiver, and material to be distilled is pumped from the lower receiver by a magnetically operated pump. The still is run at a given temperature, and the lower receiver emptied, distillate being collected and removed, and residue collected in the

upper receiver. Then by means of a magnetically operated ball valve the residue is transfered to the lower receiver. The still temperature is then raised and the residue recirculated.

The distillation can thus be accomplished in a number of steps each at a definite temperature, and the results obtained can be used to provide analytical data by plotting an elimination curve. By means of the latter it is possible to obtain information as to the characteristics of small concentrations of substances (*e.g.* vitamins) in the oil. In many cases it is necessary to add to the distilland a constant yield oil, *i.e.* one which is distilled in constant increments as the temperature is raised. The preparation of such an oil is described, together with an interpretation of the various shapes of elimination curve obtained. P. D.

53. Efficiency and Capacity of a Bubble-Plate Fractionating Column. C. C. Peavy and E. M. Baker. *Industr. Engng Chem.*, 1937, **29** (9), 1056.—Tests were made on a three-plate column 18 ins. in diameter, with plate spacings of 6, 12 and 18 ins. The binary mixture used was water–ethyl alcohol. The depth of liquid on the tray was varied to give heights above the slots of 0, 0·5, 1 and 2 ins. Entrainment was measured colorimetrically.

The concentration gradient across the plate was found to have a marked effect, efficiencies as high as 120% being obtained. Values of the order of 85% were obtained for the local or point efficiency.

The entrainment obtained was found to be a function of the linear velocity divided by the specific volume, and the results of other workers are correlated on this basis.

The effect of entrainment on efficiency was calculated by means of Colburn's equation (*ibid.*, 1936, **28**, 526).

Plate efficiency is unaffected by the reflux ratio over a range $\frac{L}{V}$ equals 1·0 to 0·7.

P. D.

Motor Fuels.

54. Use of Acetals as Motor Fuels. S. Doldi. *Chim. e Industria*, 1937, **19**, 369–372.—Experiments have shown that acetals are not only valuable solvents but that they can also be used as motor fuels. Dimethyl acetal (synthesised from acetylene and methyl alcohol and purified by treatment with calcium chloride) is practically of equal value to ethyl alcohol as a blending agent for benzine and methyl alcohol. The stability of the blend in respect to temperature and humidity is increased. Acetal is superior to ethyl alcohol as a constituent of motor fuel. C. C.

55. Value of Octane Numbers in Flying. D. P. Barnard, *J. Soc. Aut. Engrs.*, 1937, **41**, 415–420.—This paper gives an analysis of the increased earning power of certain types of aircraft directly attributable to increase in fuel octane number. Methods are given of calculating revenues, and earning capacities per gallon of fuel as affected by octane number are shown graphically. The article is not intended as an exact computation of the earning power of any particular improvement of knock rating, but merely seeks to show the probable effects of the present general trends in design. Although it is rarely possible to increase the earning capacity of an existing machine by merely increasing the anti-knock value of the fuel, the fundamental worth of such fuel changes as permitting changes in design of the craft and power plant must be recognized. The author's main conclusions are as follows :—

Depending on type of craft and operating conditions, the value of an increase of one octane number may be from 2 to 8 cents./gal.

For moderate anti-knock increases, raising compression ratio seems to offer a slight economic advantage over supercharging, whilst above 100 octane number a distinct improvement in earning power for increasing supercharge is indicated. 1% reduction in heating value of the fuel is equal to about 2 octane numbers in loss in earning capacity.

The increase in earning capacity possible with higher octane number fuel more than offsets the increased cost of such fuels. C. H. S.

56. Effect of Altitude on Anti-knock Requirements of Cars. N. MacCoull, K. L. Hollister and R. C. Crone. *Oil Gas J.*, 12.11.37, **36** (26), 130; *Refiner*, 1937, **16** (11), 534.—The results are presented of an investigation on the effect of altitude on the octane requirements of a typical group of 1937 cars with the conventional straight-run series of secondary reference fuels and with a corresponding series of cracked fuels. At the same time, the effect of altitude on the correlation between the car and laboratory anti-knock ratings on a series of cracked fuels was examined.

With the twelve cars tested, it was found that the rate of decrease of the octane rating required to suppress knock varied from three per 1000 ft. elevation from sea level to 7·5 units at 12,000 ft. At over 4000 ft. corresponding to a large area of the western plains, none of the cars required over 63 octane, although some required 78 at sea level. In at least seven states in this area a gasoline of about 5 octane units lower than at sea level could therefore be used. Carburettors adjusted at sea level deliver too rich a mixture at altitudes, improved acceleration being obtainable, however, by using smaller jets at the expense of slight increase in octane requirements. The average for all cars varied from 69 at sea level to 52 at 5100 ft. to 49 at 6000 ft. to 18 at 12,100 ft. Four cars failed to knock on heptane at 12,100 ft. With the cracked fuels the car requiring the highest octane fuels appreciated the cracked series of fuels by 6 (*i.e.* showed a 72 O.N. cracked stock as good as a 78 O.N. straight-run stock), the difference diminishing with the octane requirements of the car, one car depreciating the cracked stock by 1·5 units. In general, the anti-knock requirements with altitude were only slightly less with cracked than with the straight-run series. At sea level the average octane requirement was 1·5 lower when using cracked fuels than with straight-run reference fuels, at 6000 ft. the position being reversed.

Full details of the method of carrying out the tests are included. C. L. G.

57. Aircraft Operation with Fuels of 100 Octane Number and Higher. S. D. Heron. *Oil Gas J.*, 13.11.37, **36** (26), 185; *Refiner*, 1937, **16** (11), 521.—A discussion is presented of the history of fuel and concurrent aircraft engine development, the effect of octane number on engine performance, the relation of engine to aircraft performance and the relation of engine performance to aircraft earning capacity.

The gains in engine performance due to 100 octane fuel in place of 87 fuel are summarized as power increase of up to 30%, reduction of cruising fuel consumption of 10–15% and the probable attainment of cruising fuel economy closely comparable with that of a C.I. engine. Although a 10% increase in power produces not more than a 3% increase in speed, the ability to maintain power at increasing altitude has a large effect on speed. Thus, at 10,000 ft. the reduced air density increases the speed by 20%, this being obtained by more supercharging. The value of increased take-off power is in reducing the take-off run and distance travelled before an obstacle of given height can be cleared. It is calculated that with large multi-engine transport a 20% increase in take-off will reduce by 45% the distance required to take off and reach a height of 50 ft. Thus, the availability of 100 octane fuel for take-off would decrease the size, and accordingly the cost of air ports. For flying-boats increase in take-off power reduces the length of run which is liable to cause engine overheating, and is of particular value for long-distance non-stop operation, where crew, fuel oil and equipment loads now represent 90% or more of the disposal load. Fuels costing as much as $50 a gallon would be economically justified if they rendered possible an unassisted take-off for seaplanes for which catapulting methods are being considered.

Increase of octane rating may be used to increase airplane range by (1) increasing the take-off horse power by more supercharging and thus allowing a greater fuel load to be carried, (2) increasing the compression ratio to give minimum fuel consumption with the fuel to be used for cruising, (3) increasing the compression ratio to have a noticeable effect on cruising fuel consumptions and yet permitting a considerable increase in take-off power.

The calculated increased earning power of 100 octane fuel over 87 octane varies from 2 c. to $1·97 per gln. There is therefore an immediate field for 100 octane fuel in existing commercial aircraft, and more particularly for military aircraft.

C. L. G.

58. Patents on Motor Spirit. British Celanese Ltd. E.P. 474,556, 3.11.37. Preparation of high anti-knock motor spirit by mixing hydrocarbons with oxidation products of butane and methyl or ethyl alcohol.

N.V. de Bataafsche Petroleum Mij. E.P. 474,567, 3.11.37. High anti-knock gasoline prepared from naphthenic gasolines by subjecting the latter to catalytic dehydrogenation and subsequent extraction with a selective solvent for aromatic hydrocarbons and the gasoline obtained from the extracts.

Non-Poisonous Gas Holding Co. Ltd. E.P. 473,722, 19.10.37. Manufacture of motor fuels from wood, peat, etc., by destructive distillation at 400–480° C. and steaming the distillation residue at the same temperature in a separate chamber to obtain methane and hydrogen from the water gas.

W. A. Craig. U.S.P. 2,094,585–2,094,586, 5.10.37. Refining of cracked spirit in the vapour phase with zinc and calcium chlorides.

R. B. Day. U.S.P. 2,096,163, 19.12.37. Refining of motor spirit by treating it at the b.p., with added hydrogen chloride in the presence of steam and zinc chloride.

R. B. Smith. U.S.P. 2,096,700, 19.12.37. Improved apparatus for stripping absorbed gasoline from the absorbent media.

H. Tropsch. U.S.P. 2,096,769, 26.10.37. Increasing the anti-detonating character of gasoline by subjecting the vapour to the action of an aluminium oxide catalyst at 930° F. at atmospheric pressure.

E. F. Nelson. U.S.P. 2,096,820, 26.10.37. Refining of cracked spirit with adsorbent earth.

W. T. Hancock. U.S.P. 2,097,097, 26.10.37. Refining of cracked spirit by passing it together with a stream of flue gases containing free oxygen and steam, through adsorptive material at 300–500° F. and under pressure. W. S. E. C.

Gas Oil, Diesel Oil and Fuel Oils.

59. American Picture—Diesel Fuel Research. C. G. A. Rosen. *J. Soc. Aut. Engrs*, 1937, **41**, 393–399.—This paper deals with experiments carried out with a single-cylinder pre-combustion chamber engine, and is intended to supplement the recent paper by Boerlage and Broeze dealing as it does with a third type of combustion chamber not dealt with by these authors. The work is confined to California base fuels of widely varying physical characteristics. The ignition quality of fuels was determined by the throttling method developed by the author. Fuel-spray characteristics were investigated using a special apparatus consisting of a "look box" with synchronized neon lamp and facilities for speed control and varying pressures; thus the behaviour of the spray into open atmosphere can be correlated with data obtained under cylinder compression pressure. Photographs are given showing the effect of viscosity on penetration and dispersion. Flame propagation can be observed in this engine by means of a quartz window fitted in cylinder head and stroboscope and phase-changing device.

Many graphs are given showing the effects of varying spray characteristics, cooling water temperatures, fuel viscosity and volatility, and ignition quality on flame duration and engine performance. The effects of compounded lubricants and varying ring-belt temperatures on the products of incomplete combustion are also discussed.

C. H. S.

60. Reasoning Behind Diesel Fuel Specifications. T. B. Rendel. *Oil Gas J.*, 14.10.37, **26** (22), 67.—The maximum development in high-speed diesel engines has been in those operating at about 1700 r.p.m., so that the refiner should aim at providing fuels for this type of engine. The reasoning underlying the formulation of A.S.T.M. specifications 1D and 3D, and the W.R.P.A. specifications takes into account (*a*) the handling of the fuel from the refinery to the engine-fuel valve admitting the fuel at the proper time and in the proper form of spray to the combustion chamber, and (*b*) the supplying of fuel at this valve which will burn completely in the combustion chamber without objectionable exhaust smell or deposits. (*a*) includes viscosity, pour point and cleanliness, and (*b*) ignition quality, sulphur content, viscosity and volatility characteristics.

Viscosity and Pour Point. Too low a viscosity may cause leakage past the fuel pump plunger and injection valve, upsetting the timing and amount of fuel injected and increasing wear, whilst too high a viscosity and pour point may cause feed trouble at low temperatures. The viscosity also affects the spray characteristics given by a particular design of nozzle, as low viscosity fuels give fine atomization and broad dispersion but shortened penetration, whilst high viscosity fuels offer more resistance to atomization, causing greater penetration with less dispersion. With distillate fuels of viscosity below 50 secs. S.U. at 100° F., the differences are small enough to be ignored in most types of combustion chambers, but higher viscosity fuels, particularly those containing large quantities of residual fuel, result in carbonizing of the nozzle.

Cleanliness. Specifications for B.S. and W. and ash control the product as it leaves the refinery, but more attention should be paid in the handling of fuels to avoid contamination, and in engine operation to avoid abrasive grit entering the system.

Ignition Quality. The delay period is made up of the physical delay during evaporation and the chemical delay in ignition of the vapours, and is affected by engine design (provision of hot spots and turbulence). For light fuels the cetane value is largely dependent on the chemical composition, but for heavier fuels the volatility is important. It also plays a part in the third ignition period of the fuel, appreciable quantities of heavy residue causing late burning, resulting in incomplete combustion and heavy corrosion. This is frequently apparent from the exhaust in the acrid odours of the aldehydes and organic acids formed. It also causes carbonizing of the nozzles, interfering with the spray formation, and is best combated by cooling the surface of the nozzle. The volatility of the fuel is based on the A.S.T.M. distillation test (for light fuels) and the Conradson carbon test (for heavy fuels), but some common basis is desirable. C. L. G.

61. Essentials of Fuel Utilization in Diesel Engines of Automotive Type. R. Best. *Oil Gas J.*, 7.10.37, **36** (20), 107.—The course of events in actual automotive diesel engines does not follow the usual concept of the diesel cycle, since the early portion of the combustion occurs substantially at constant volume and not at constant pressure. Thermally this cycle is superior to the diesel cycle, but every effort is made to decrease the proportion of fuel burned at constant volume, as this part of the combustion increases pressures, the rapid rise in pressure frequently causes roughness and knock, and combustion temperatures are also increased.

Rapid pressure rise may be controlled to an extent by many factors of engine design and conditions of operation, but the effect itself may be ascribed to the fuel. The research work which has been carried out on the evaluation of ignition delay of fuels, the relation between ignition delay and ignition temperature and factors affecting ignition delay is briefly summarized. A general relationship between results obtained by various physical methods and the cetane number of fuels by the delay method is provided in graphical form.

Some of the design details employed to bring the fuel into intimate contact with all of the oxygen available are: (1) Nozzles designed to give sprays of certain geometrical forms found by experiment to be superior. (2) Combustion chambers made to fit the spray or designed to give a certain degree of turbulence to the charge. (3) Hot plates or hot walls designed to vaporize impinging fuel. Fuel factors which are also of importance in achieving this objective are: (*a*) viscosity, (*b*) surface tension, (*c*) specific gravity, (*d*) volatility, (*e*) cleanliness. Since relatively little work has been done in the examination of these factors, only general statements can be made at this time. The first three decide the relative penetration, dispersion and atomization of fuel sprays. Viscosity affects pump leakage and lubrication, and consequently a minimum value is usually specified. Experiments indicate that at low injection pressure the mean diameter of fuel droplets on injection decreases roughly in proportion to viscosity; at higher pressures the effect of viscosity diminishes and the effect of surface tension assumes more importance. The principal effects of specific gravity are on the penetration of the fuel charge and the resulting spray cone angle. Heavier oils penetrate deeper into the combustion space, but have a narrower cone angle, resulting in a net decrease in distribution. The immense importance of ensuring that clean fuel is used is stressed. It is the responsibility of the refiner to deliver clean fuel, but it is also the responsibility of operators to keep contamination in storage to a minimum and to ensure that engine filters are efficient. Troubles due to

erosion and corrosion as a result of contamination are discussed. Operation in cold climates necessitates use of a fuel having a pour point a few degrees lower than the lowest temperature of operation.

All these factors are intimately associated with each other and with the conditions of operation. For example, an increase in volatility of fuel might increase roughness, because, when ignition occurred, there would be more fuel in the cylinder prepared for combustion. There is probably a disadvantage in shortening the delay period more than necessary, as this results in a less efficient cycle, and at least one manufacturer specifies a maximum as well as a minimum value for ignition quality. Recently it has been shown that when an engine has a sufficiently high compression ratio, either high or low cetane value fuels may be burned smoothly or roughly, depending on simple adjustment of the injection advance angle. R. A. E.

Lubricants and Lubrication.

62. New Apparatus for the Determination of Oiliness in Lubricants. A. W. Ralston, E. J. Hoffman and E. S. Stephens. *Nat. Petrol. News*, 3.11.37, **29** (44), R. 288.—Three half ball bearings held in a steel plate and attached to a motor rotating at 120 r.p.m. bear upon a machined steel disc, the load being adjustable through a spring. The bearing assembly is enclosed in a cup filled with oil, the temperature rise being determined at 5-min. intervals during a 90-min. run. The machine has been used to investigate sundry oiliness dopes. The results have shown that xylylheptadecyl ketone and phenoxyphenylheptadecyl ketone both have film-forming properties.

H. G.

63. Anomalies in the Viscosities of Mineral Oils at Low Temperatures. M. Jordachescu. *Ann. Off. Combust. liq.*, 1937, **12**, 511–549 and 735–775.—At low temperatures, round about the pour point, all oils become plastic, entering a physical state intermediate between solid and liquid. This plasticity is shown by the following phenomena:

(1) Changes in viscosity with time until finally stability is reached.
(2) Thixotropy.
(3) Lack of proportionality between V and p.
(4) Turbidity.

The factors affecting viscosity measurements in the cold using capillary apparatus are the diameter of the capillary tube, the temperature, and the heat treatment of the oil. The yield value, representing the degree of plasticity of the oil, increases as the diameter of the tube decreases. For a certain value of the diameter the yield value is nil, and the delivery varies as the pressure. In spite of having the appearance of a liquid with normal flow, however, the oil remains plastic.

Applying the formula of Buckingham, it was found to give satisfactory results only for the straight part of the delivery–pressure curve. The yield-value also varies with the temperature, rising as this is reduced.

The plasticity of a mineral oil begins at a fixed temperature, and increases steadily as the point is approached where the oil will no longer flow. Heat treatment of the oil previous to chilling affects the yield value, and also the time taken to reach stability of viscosity. Refining the oil and the presence of various substances such as petrolatum alter the temperature at which plasticity begins. These anomalies in the viscosity might be explained by the formation of a crystal lattice in the cold. The slow formation of the lattice corresponds to the time necessary to reach stability, whilst the yield value can be related to the resistance to rupture of the lattice. It is considered to be established that crystals are formed in frozen oils.

The theory is advanced that a simple substance which crystallizes normally should not become plastic, whilst a mixture of two simple substances, with centres of crystallization not too far apart, would be plastic because of the hampered crystallization of one of the bodies, giving rise to a structural state which is not isomorphous.

Two new properties of oils have been demonstrated: elasticity and rigidity. These seem to be related to the plasticity. They appear at or near the temperature where the oil becomes plastic, and, like the plasticity, they increase as the temperature is reduced. W. E. J. B.

64. Effects of Pressure on Viscosity of Oils and Chlorinated Diphenyls. R. B. Dow, M. R. Fenske and H. E. Morgan. *Industr. Engng Chem.*, 1937, **29** (9), 1078.—Viscosities of three oils were determined at 130° and 210·2° F. and at pressures up to 50,000 lb. per sq. in. approx. in a rolling sphere viscometer. The oils were a Pennsylvania oil (V.I. 102) a Californian oil (V.I. 16) and a Californian oil + Paratone (V.I. 100), all having the same viscosity, 42 centipoises, at 130° F. The increase in viscosity with pressure was greatest for the Californian oil and least for the Pennsylvanian at both temperatures.

The viscosities of two Aroclors (chlorinated diphenyls) were determined at 86° and 167° F. One of these showed the remarkable viscosity increase of fifteen-fold for a pressure rise of 3500 lb. per sq. in., which is the greatest increase to have been measured for any liquid. P. D.

65. Adulteration of Mineral Lubricants with Vegetable Oils. A. Balada. *Petrol. Z.*, 6.10.37, **33** (40), 1–8.—Engine tests show inferiority of adulterated oils.

J. W. J.

66. Journal-bearing Design as Related to Maximum Loads, Speeds, and Operating Temperatures. S. A. McKee. *Bur. Stand. J. Res.* (*Wash.*), 1937, **19** (4), 457–465.—The present-day trend towards the speeding up of all types of machinery has resulted in the use of higher speeds and loads with journal bearings. In many cases the designer is probably more interested in the extreme conditions of load and speed at which a given bearing will operate successfully than he is in its performance at normal running conditions.

From this standpoint a rational basis for design would appear to be the determination of the maximum allowable loads and speeds predicted upon two primary considerations: (1) that the bearing shall always operate in the region of stable lubrication, (2) that the operating temperature of the bearing shall never exceed some fixed value.

Equations are given for the rate of heat generated and the rate of heat dissipated in terms of factors of operation and construction. Since for equilibrium operating conditions these must be equal, the two equations can be combined to yield an expression which indicates approximately the relation between the rise in temperature of a bearing above its surroundings and the other factors involved when it is operating in the region of stable lubrication.

The product—maximum allowable pressure × speed at which a bearing will function under conditions of safety—is obtained by substituting in the above relation permissible values for the temperature rise and the generalized operating variable $\frac{ZN}{P}$. In the latter expression, Z is the absolute viscosity of the oil at atmospheric pressure and bearing temperature, in centipoises; N is speed of journal r.p.m., and P is pressure on projected area of bearing lb./in.^{2}

A numerical example is given to illustrate the application of the method, and individual values for the maximum permissible pressure and speed for a given bearing, using a given lubricant, are obtained from the equation for the product of the speed and pressure and the minimum permissible value of $\frac{ZN}{P}$ for stable lubrication.

The method as outlined is directly applicable to self-cooled bearings, but it may be made applicable to independently cooled bearings by the insertion into the appropriate equation of suitable factors relating to the characteristics of the cooling system.

D. L. S.

67. Patents on Lubricating Oil. Deutsche Erdol, A.-G. E.P. 473,100, 6.10.37. Solvent extraction of waxy lubricating oil in two stages: first with phenol, liquid SO_2, furfural, etc., and treating the raffinate obtained with a diluent, *e.g.*, benzene.

A. W. Nash, T. G. Hunter, W. R. Wiggins and I.C.I. Ltd. E.P. 473,334, 7.10.37. Refining of chlorinated paraffin wax which has been prepared using aluminium chloride, by treating the crude product below 200° C. with ammonia.

G. Zotos. E.P. 473,345, 11.10.37. Improved apparatus for reconditioning lubricating oils.

Armour & Co. E.P. 473,846, 20.10.37. Lubricant consisting of a mineral oil and 0·1–1·0% of Friedel Craft's reaction product from a coal-tar fraction, *e.g.* anthracene and stearyl chloride.

Ruhrchemie A.G. E.P. 473,935, 22.10.37. Catalytic conversion of cracked products into lubricating oils in which the spent catalyst is regenerated by adding small quantities of fresh catalyst.

C. Creango. E.P. 474,057, 25.10.37. Production of lubricating oil directly from mazout or its distillates. The mazout is first treated with activated bleaching earth to obtain a powder form of homogeneous mixture, and the oil dissolved by means of solvents. The extract is separated and distilled—the residue consisting of refined mineral oil.

C. C. Wakefield & Co., Ltd., and E. A. Evans. E.P. 474,156, 26.10.37. Addition of 1% by wt. of a nickel soap and an organic compound of tin or lead to lubricating oil to prevent sludge formation.

Socony-Vacuum Oil Co., Inc. E.P. 474,240, 27.10.37. Reduction of pour point of lubricating oils by adding a small quantity of wax-substituted phenol.

Edeleanu Gesellschaft m.b.H. E.P. 474,464, 2.11.37. Solvent extraction of hydrocarbon oils using dichlorodifluoromethane in the presence of H_2SO_4 at normal or increased temperatures. The resulting resinous products, acid sludge and asphaltic substances are removed from the oil.

E. W. Gardiner, J. W. Greene and A. G. Lyman. U.S.P. 2,094,593, 5.10.37. Production of synthetic hydrocarbons of high viscosity index by chlorinating straight-chain paraffin hydrocarbons to a chlorine content of 3–6% by wt., and dechlorinating the chlorohydrocarbons formed with silica gel.

W. B. McCluer and M. R. Fenske. U.S.P. 2,094,802, 5.10.37. Solvent refining of Pennsylvanian grade residuum oil with paraldehyde.

C. B. Foley. U.S.P. 2,095,470, 12.10.37. Method and apparatus for purifying insulating oils for use in electrical apparatus.

W. F. Faragher. U.S.P. 2,095,972, 19.10.37. Solvent extraction apparatus.

L. S. Wilbur. U.S.P. 2,096,220, 19.10.37. Process of cleaning dirty oils.

C. E. Andrews and M. R. Fenske. U.S.P. 2,096,725, 26.10.37. Separation of gasoline, kerosene or lubricating oil into fractions having different chemical and physical properties by mixing the oil with methylamine so that at least two phases form, separating the phases and removing the methylamine.

M. Maxwell. U.S.P. 2,096,909, 26.10.37. Preparation of a yellowish-green bloom agent for lubricating oils by contacting asphaltic residuum having a flash point approximately that of a cylinder oil, with clay at 650–750° F. for 1–6 hrs. The clay is then removed from the resulting bloom agent.

R. E. Manley. U.S.P. 2,097,127, 26.10.37. Production of low pour point lubricating oil by solvent refining of lubricating oil with furfural and dewaxing the raffinate with acetone-benzol. The wax separated is chlorinated, and the chlorinated wax is condensed with the extract from the refining in the presence of a Friedel Craft catalyst. A minor proportion of a pour-point depressant material separated from the condensation products is then added to the partly dewaxed lubricating oil.

C. C. Towne. U.S.P. 2,097,245, 26.10.37. Lubricating oils rendered fluorescent by adding a small proportion of a heavy condensate recovered from high-temperature pyrolysis of a normally gaseous unsaturated hydrocarbon. W. S. E. C.

Asphalt and Bitumen.

68. Patents on Asphalt and Road Materials. Thermal Industrial & Chemical Research Co., and E. Arnold. E.P. 474,163, 27.10.37. Process for coating mineral aggregate with tarry or bituminous binding materials in which a filler is added to the aggregate prior to the addition of the emulsion or binding material.

R. E. Wilson. U.S.P. 2,096,949, 26.10.37. Refining pressure tar by mixing it with liquefied normally gaseous hydrocarbons consisting of 2–4 carbon atoms at 50–150° F. under pressure to maintain the hydrocarbons in the liquid phase. The insoluble portion is blended with a blending oil derived from pressure tar to produce road oil. W. S. E. C.

Detonation and Engines.

69. Combustion Levels in Flame Gases. W. T. David. *Engineering*, 12.11.37, **144** (3748), 531.—It is shown that the temperature of a flame does not normally reach the theoretical maximum on account of part of the energy being in a latent form, and the "combustion level" does not therefore reach 100%.

The combustion level can be raised by various methods, particularly by increasing the initial pressure. Figures are given for combustion levels in various types of combustion in which a variation of from 72 to 99% is demonstrated. J. G. W.

70. Some Notes on the Performance of Piston Rings in Relation to Medium-Speed Diesel Engines. F. C. Caistor. *Diesel Eng., Us. Ass.*, S. 140.—Details are given of some experiments carried out on five 200-k.w. generating sets running at 650 r.p.m. Troubles had been experienced with excessive lubricating oil consumption, and various modifications to the piston and the pressure and scraper rings were tried before any reduction in the consumption was effected. J. G. W.

71. Design Developments in European Automotive Diesel Engines. H. H. Ricardo and J. H. Pitchford. *J. Soc. Aut. Engrs.*, 1937, **41**, 405–414.—This paper gives a general review of the general requirements which have to be met in the design of a high-speed diesel engine for automotive work. Each of these requirements is discussed, and the advantages and disadvantages of the various types of combustion chambers are analysed. The development of the newer type air-swirl combustion-chamber is described where the actual swirl-chamber contains only half the total quantity of air, the other half remaining in cavities in the piston crown. Another variation of the compression-swirl system has been devised which is claimed to give exceptionally good cold starting, and the author states that with this type head it is possible to hand start a 4 × 4½ in. engine on 45 cetane fuel at 10° F. or on 28 cetane fuel at 32° F. This system is now in full production by one of the largest producers of oil-engined vehicles in Europe. A general review is given of the mechanical construction of present-day European high-speed automotive diesel engines, together with some notes on the more persistent troubles and how they have been alleviated or overcome. The economic aspects of C.I. engine operation is discussed, and the paper concludes with a survey of the present uses of the high-speed diesel engine, and probable future trends. C. H. S.

72. Diesel Express Trains of the German State Railways. N. Lauff. *Petrol. Times*, 20.11.37, **38** (984), 677.—The statement that diesel trains had proved uneconomic on the German railways is absolutely unfounded. The temporary suspension of diesel services was due to the necessity for axle replacement. The "Flying Hamburger" type of train is claimed to be completely successful and economically and technically efficient. L. O.

Coal and Shale.

73. Patents on Coal. J. Swallow. E.P. 473,886, 20.10.37. Improved apparatus for the distillation and coking of coal-oil mixtures.

N. H. Freeman. U.S.P. 2,095,863, 12.10.37. Extraction of liquid hydrocarbons from coal or shale by passing the raw material successively through a series of heated chambers at progressively increasing temperatures. W. S. E. C.

Economics and Statistics.

74. Motor Industries of United Kingdom and Germany Compared. L. Owen. *Petrol. Times*, 13.11.37, **38** (983), 640.—Statistics available from 1933 to 1936 show that the German motor industry is expanding at over three times the rate of its British competitor. The total vehicle production in Germany during 1936 was 65·06% of that of the United Kingdom. L. O.

75. Post-Depression World Oil Production and Zones. L. Owen. *Petrol. Times*, 4.12.37, **38** (986), 733.—An analysis of the production figures from 1932 onwards shows that the increase in world output very nearly follows a smooth curve defined by a cumulative per cent. increase of 8·282% per annum. From 1880 to 1930 the increase, similarly calculated, was 8·0443% per annum. The similarity of these figures, and the slight increase for the latter period, indicate that the petroleum industry has recovered from the 1930–1932 slump and is slowly regaining lost ground.

The world's oilfields may be divided into three zones: American Continent, and Eastern Hemisphere with outlets north and south of the Suez Canal respectively. The average increase per annum in these three zones is 8·43%, 8·34% and 6·81% respectively. L. O.

76. Reliability and Accuracy of World Production Figures. K. Dijk. *Petrol. Times*, 27.11.37, **38** (985), 694.—Discrepancies in the figures for world petroleum production prove the necessity for an organization of statistics. It is pointed out that discrepancies are due to the use of uniform weight–volume conversion factors, irrespective of the varying specific gravity of the oils of differing derivation. The Statistical Department of the Royal Dutch convert barrels and other volume units into tons, using the most exact data available with reference to specific gravities. A close approximation is thus obtained to the true weight figure, although it is recognized that exactitude is quite beyond practical attainment. L. O.

77. Third Five-Year Plan (1938–1942) in the Russian Petroleum Industry. I. Ganitzki. *Monit. Petr. roum.*, 1937, **38**, 1485–1487 and 1559–1561.—The Ural region is expected to produce 9,100,000 tonnes of crude in 1942, against 2,425,000 tonnes in 1937. This will mean that in 1942 this region will produce 16% of the national output, against 8% in 1937. The Caucasian group, Baku, Groznyi and Maikop, which provided 86·5% of Russia's crude in 1937, will provide 75% in 1942. The remainder is accounted for by the Central Asia, Sakhaline and other lesser regions. Although by 1942 production will have increased by 78%, it is expected that this will be insufficient for internal consumption, so several economies have been decreed to conserve supplies by preventing wasteful use of petroleum products. Among these is the utilization of peat and brown coal, and the production of synthetic liquid fuels, including those from bituminous shales. There is also much more attention to be paid to conservation of natural gas and to the use of this gas in the place of oil fuel consumed by industry. There will also be big developments of the lamp-black industry. Wherever possible, great industrial consumers, such as electric-power plants, are replacing fuel oil by gas from brown coal and bituminous shales; by 1942 several million tonnes of oil will be thus released for cracking, etc.

Efforts will be made during the 1938–1942 period to reduce the time lag between discovery and operation of new wells, to increase the average depth of wells, and to increase the speed of drilling, the latter point being greatly helped by the advent of hard alloys for facing drilling bits. The average depth drilled per unit per month was in 1937 about 732 metres.

85% of the crude oil produced was processed in 1937, and there does not appear to be any likelihood of this percentage being increased by 1942. This would mean a processing of about 48,000,000 tonnes, of which 9,800,000 tonnes will be spirit and ligroin, and 11,200,000 tonnes lamp oil. Approximately 1,800,000 tonnes of ligroin

will be produced, and will apparently be consumed mainly by caterpillar tractors. The development of these tractors is of great importance to the Russian petroleum industry. Since being put into production in 1933, 55,900 had gone into service by the end of 1936, and by the end of 1937 97,000 were expected to be in service. These tractors are of 48–60 h.p., and the big factories of Tchelecbinsk have a potential capacity of 40,000 tractors per year.

A new scheme starting in 1938 will produce diesel tractors of 75 h.p. to run on a heavy gas oil (solar oil). This development will obviate a ligroin shortage.

The Stalingrad factories, which up to 1937 produced over 200,000 15–30-h.p. tractors (S.T.Z.1 Type) which use lamp oil as fuel, will now produce only 30–40-h.p. tractors (Type S.T.Z.) at a rate of 40,000 per year. By 1940 these factories will be on the production of diesel tractors.

The position regarding spirit is becoming serious in Russia, owing to the immense growth in the production of automobiles—750,000 vehicles will be constructed in 1942. As there is no likelihood of an increase in the spirit production, the automobile industry must look to alternative fuels such as diesel oil, gas, synthetic petrol or alcohol blends.

The next few years will see little or no export of spirit, ligroin, lamp oil or gas oil from Russia. T. C. G. T.

BOOK REVIEWS AND BOOKS RECEIVED.

Book Reviews.

Petroleum Production. By Wilbur F. Cloud. Pp. 613. Tables 75. Illustrations 280. University of Oklahoma Press; Norman. 1937. $5.00.

Petroleum Production provides a welcome addition to the literature on petroleum subjects. It is a book which is invaluable to the student and executive, who will find a wealth of information in its 600 pages dealing with the subject from the American standpoint. The subject of petroleum production, which in the early days of the industry was given small consideration, is now being dealt with on scientific lines, which are summarized in the present book. The first of the sixteen chapters of the book deals with legal aspects of the industry, including the acquisition of titles to oil lands, with specimen leases, assignments, contracts, state laws and regulations. The study of composition of various oil sands and production relationships is followed by an excellent chapter on oil-field development. Oil-well completion, which is dealt with exhaustively, includes a valuable table summarizing drilling and production on ten major fields of the U.S.A. The advantages and disadvantages of cable tool and rotary drilling are carefully reviewed, many types of mechanism being considered. Further chapters deal with such important phases as flowing wells and those mechanically operated, including the many problems met with. Cleaning, re-conditioning and re-pressuring are fully discussed, as in fact is every phase of production from drilling to final storage of the oil.

The book is profusely illustrated, and numerous formulæ, curves and tables add to its value, which is further enhanced by extensive bibliographies at the conclusion of the consideration of each phase of the whole subject.

Petroleum Production is a book which should find a place in the library of every oil company and individual occupied in this important branch of the petroleum industry.

ASHLEY CARTER.

Erdölbestandteile. By Dr. E. Waldmann. Austrian Petroleum Institute, Publication No. 9, 1937. Pp. 68. Verlag für Fachliteratur Ges., Vienna. Price £1.

The purpose of this publication is to collect in tabulated form information regarding all the chemical substances which have been identified in petroleum. The volume is divided into several sections which deal respectively with :—

(*a*) Hydrocarbons occurring in natural petroleum, sub-classified into paraffins, *cyclo*paraffins, polynaphthenes and aromatics.
(*b*) Hydrocarbons occurring in cracked petroleum, similarly sub-classified, with the addition of olefines, diolefines and acetylenes.
(*c*) Carboxylic acids (naphthenic acids).
(*d*) Phenols.
(*e*) Sulphur compounds, sub-classified into mercaptans, alkyl sulphides, cyclic sulphides and thiophens.
(*f*) Nitrogen compounds.

The tables give the formula, structure, some of the more prominent physical constants (boiling point, freezing point, density and viscosity), the petroleum from which they were isolated and a short bibliography. In compiling this bibliography special attention has, very wisely, been given to recent publications, such as those from the Bureau of Standards, which may be accepted as reliable. Petroleum chemists know only too well the extremely doubtful values of much of the early work on the identification of the chemical entities present in petroleum.

The volume has been carefully and thoroughly prepared and is excellently presented. It cannot be expected to appeal to a wide circle, although it may be useful as a work of reference for a limited number of laboratories specializing in petroleum chemistry. This no doubt is the reason for the somewhat high price of the book.

F. B. THOLE.

Motortreibmittel. By Dr. C. Walther. Pp. 108. Steinkopff, Dresden, 1938. Price 6 R.M.

This constitutes No. 41 of a series of those technical monographs dealing mainly with the mineral oil, fatty oil and fuel industries which Germany has the reputation for producing cheaply and very efficiently.

Dr. Walther needs no introduction to petroleum technologists, for his publications are widely known. In this monograph he has concentrated an enormous amount of information into a severely restricted space. The scope of the book is indicated by the chapter headings, which are as follows :—

(1) Fuels and Motors—dealing mainly with the theory and practice of "knocking" in engines.
(2) Distillation and gasoline recovery, including coal carbonization.
(3) Liquid fuels from gaseous hydrocarbons, including polymerization and alcohol production.
(4) Cracking.
(5) Hydrogenation.
(6) Refining, both as regards petroleum and coal products.
(7) Gaseous fuels.

Naturally the space available leaves no opportunity for more than the briefest treatment of any aspect of the subject under discussion, and for this reason the book is hardly likely to appeal to petroleum technologists, although it certainly gives an excellent bird's-eye view of the wide subject of natural and synthetic liquid fuels, and would be excellent reading for one who was interested in the subject but who did not require detailed knowledge of it.

Dr. Walther has really successfully achieved an almost impossible task in producing such a concentrated essence of information and, in particular, he deserves commendation for the excellence of the bibliography which accompanies each page.

F. B. THOLE.

The Principles and Practice of Lubrication. By Alfred W. Nash and A. R. Bowen (2nd Edition, 1937). Pp. 345 + ix. Chapman & Hall, London. Price 18*s*.

Considering the tremendous importance of lubrication in a mechanical age, it has long been surprising that so few authoritative books on this subject exist—much fewer than have been written on the subject of fuels.

The first edition of this book was published in 1929, which, as any petroleum technologist will appreciate, means that it is obsolete, so great have been the advances in our knowledge of lubricants in the past decade. It is therefore with much gratification that we find that a new and up-to-date work (for the book is this rather than a second edition) has become available.

The planning of the scope of the book has been well conceived, the sections dealing with the mechanical, the chemical, the manufacturing and the utilitarian aspects of the subject each receiving their fair share of attention. The range covered may be indicated by quoting some of the chapter headings—and they are substantial chapters too :—

Chapter II.	Friction.
Chapter IV.	Design and Lubrication of Bearings.
Chapter V.	Source of Lubricants
Chapter VI.	Chemistry of Lubricants.
Chapter VII.	Chemical and Physical Tests for Lubricating Oils.
Chapter X.	Care of Lubricants.

In any book of this class, where material far exceeds the space available, any critic can of course find grounds for complaint that matters of importance have been omitted or given inadequate space. The authors' task of deciding what to omit must have been most trying. The present critic, for example, would have liked to see an adequate section on oxidation tests, since these are really of great importance and deserve more than the two pages allotted to them. The authors, however,

have done their best to remedy such shortcomings by appending to each chapter a good bibliography.

This book will be as useful in its sphere as the larger but parallel book by Nash and Howes on Industrial Fuels, and can be strongly recommended.

F. B. THOLE.

High-Speed Diesel Engines. By A. W. Judge (3rd Edition, 1937). Pp. xi + 430. Chapman & Hall, London. Price 18*s*. net.

This book has become the recognized reference book on the subject in this country, and can be well recommended to both students and also engineers engaged in either the production or use of such engines.

The high-speed diesel engine has developed and is developing so rapidly that it is difficult for a text-book to keep up to date, but the appearance of a revised edition after only four years confirms that both the publishers and the authors are determined to do their best in this direction.

In the preface the author says he has decided to retain reference to some of the obsolete types, which is good, but it would have been more helpful if he had indicated which designs are obsolete, which only experimental, and which are at present standard and proved by service experience. In this respect he is not very clear.

To be able to use the book one must study the way the subject is divided into chapters. The first five chapters give just sufficient of the theoretical side to be useful, the charts are instructive, and a very good feature is the large number of references to the source of information. The chapter on "Practical Fuel Injection Systems" is particularly good and useful.

The author has collected together a fine set of illustrations, but in many cases the reproduction is not such as to give the most help to the designer. In this respect the book falls far short of similar German technical books. A. E. EVERETT.

Books Received.

Über den Zerfall Bituminöser Strassenbau-Emulsionen. (The Ageing of Bituminous Emulsions Used in Road Construction). O. Jekel. Austrian Petroleum Institute, Publication No. 10, 1938. Pp. 118. Tables 37. Graphs 44. Verlag für Fachliteratur Ges.m.b.H., 19, Vegagasse 4, Vienna. 5 R.M.

This publication deals first with the literature concerning the determination of stability of bituminous emulsions, and then with an examination of the most important methods known for determining breakability. On the basis of detailed experimental data, it is shown that none of the known methods fulfils practical requirements. It is shown that the breaking of an emulsion produced by the stone is dependent on three conditions: (1) the activity of the stone, (2) the stability of the emulsion, (3) the magnitude of the active surface of the stone, and (4) the amount of emulsion used per unit surface of the stone. On the basis of this knowledge, a method is developed which takes into consideration all these conditions.

By means of this method it is possible to ascertain how far any emulsion with a certain sized mineral aggregate or with a mixture of different sized aggregates is capable of reacting. By employing wet stone it can be proved that the ageing of emulsions conditioned by the activity of the stone is also influenced in many cases by the moisture of the stone.

U.O.P. Laboratory Test Methods for Petroleum and its Products. Pp. 250. Universal Oil Products Company, Chicago, Illinois. 1937. $3.

Universal's analytical and control laboratories use as a fundamental background all existing test methods for petroleum products standardized by the A.S.T.M. In addition, however, many other testing procedures have been developed which are here compiled to form a group of laboratory test methods. The book is especially directed to the small refiner with limited personnel and literature facilities. It is divided into the following twelve sections: analytical procedures; asphalt and road oil; coal, shale, and lignite; coke; crude oil; fuel oil; gas; gasoline; inhibitor; kerosine and diesel fuel; lubricating oils and solvents.

Asphaltos e Sapropelitos. (Asphalts and Sapropelites). S. Fróes Abreu and R. Roquette. Pp. 84. 3rd South American Chemical Congress. July 1937. National Institute of Technology, Rio de Janeiro.

This Bulletin deals with the following four papers presented at the 3rd South American Chemical Congress held at Rio de Janeiro and São Paulo from July 8th–15th, 1937: (1) Bituminous Sandstone of Anhemby; (2) Taipú-Mirim Asphalt; (3) Sapropelic Limestone from Codo and (4) Sapropelite from Jucú.

Spirit Levelling in Texas. Part I. Western Texas, 1896–1935. J. G. Staack. U.S. Geological Survey Bulletin 883–A. Pp. 48. Index pp. 2. Superintendent of Documents, Washington, D.C. 10 cents.

This bulletin, which is to be published in seven parts, contains the results of all spirit levelling done by the United States Geological Survey in Texas. Each part deals with one of seven sections into which the State has been divided, the present part being concerned with Western Texas. In each part descriptions of the points for which figures of elevation have been determined are listed according to the quadrangles in which the points occur.

Geology and Mineral Resources of the Western Part of the Arkansas Coal Field. T. A. Hendricks and B. Parks. U.S. Geological Survey Bulletin 847–E. Pp. 224. Pocket Map. Superintendent of Documents, Washington, D.C. 25 cents.

This report describes the mineral resources of the western part of the Arkansas coal-field, and considers the features of geologic structure and stratigraphy that are essential to an understanding of the nature and occurrence of these resources. For over 30 years natural gas has been known to occur in several parts of the area, and drilling at suitable places has yielded large supplies of gas.

Geology and Fuel Resources of the Southern Part of the Oklahoma Coal Field. Part I. McAlester District. T. A. Hendricks. U.S. Geological Survey Bulletin 874–A. Pp. 87. Index pp. 2. Pocket Maps 2. Superintendent of Documents, Washington, D.C. 65 cents.

The coal deposits of this district are the most valuable of the mineral resources. Neither petroleum nor natural gas has been found in commerical quantities, but adequate tests for their presence have not been made. It is considered that natural gas may be found where there are suitable reservoirs, but the high carbon ratio of the coal suggests that only small amounts of high-gravity petroleum may be present.

Geology and Mineral Resources of North-Central Chouteau, Western Hill, and Eastern Liberty Counties, Montana. W. G. Pierce and C. B. Hunt. U.S. Geological Survey Bulletin 847–F. Pp. 264. Index pp. 6. Pocket Map. Superintendent of Documents, Washington, D.C. 35 cents.

This report describes a rectangular area of about 2600 square miles in Chouteau, Hill and Liberty Counties adjacent to the international boundary. Drilling has not revealed oil in commercial quantities, but small showings are present in several wells. Gas is apparently more abundant, and was encountered in most wells in the Eagle sandstone.

Records of the Geological Survey of India. Vol. 72. Part 3, 1937. Pp. 361. Central Book Depôt, 8, Basting Street, Calcutta. *5s.* 3*d.*

The contents comprise reports on the mineral production of India during 1936 and on a microscopical study of the Baldwin ores, Burma. Statistics are given of the production of coal, gold and petroleum for April–June 1937.

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Geology.

78. Sedimentation, Geochemistry and the Origin of Oil. K. Krejci-Graf. *Bohrtech. Z.*, June 1937, 145–147.—Organic substances accumulate in three types of deposits: in moors and bogs → peat; in muds under water with a small oxygen content → gyttja; in muds under water without oxygen but with hydrogen sulphide → sapropel. Observations show that no true relationship can be established between coal and oil deposits. The gyttja type of sediment gives rise to very bituminous combustible shales, but not apparently to oil. On the other hand, it is possible in certain places to connect sapropelic sediments with overlying oil deposits.

Work on the true composition of the various components of petroleum is very necessary in order that questions concerning the origin of petroleum may be answered. The finding of certain porphyrins in petroleum is of great significance in this respect, and points to animal and plant matter being source material. Furthermore, since these compounds are easily destroyed, anærobic conditions are necessary for their preservation. Further evidence is also obtained from the ash content of petroleums and the composition of oilfield waters. S. E. C.

79. New Methods Required to Find Future Reserves. L. G. E. Bignell. *Oil Gas J.*, 23.12.37, **36** (32), 18–19.—It is pointed out that the discovery of oil accumulations due to conditions of unconformity or wedging out of sand bodies could be considerably assisted by studying the regional geology of areas known to contain sandy horizons favourable to oil accumulation. Thus, if a well drilled in one area passed through a sand-body known to be absent in another, it would be apparent that somewhere between the two wells the sand-body had wedged out. Therefore only a few test-wells would be required to locate the exact position where the wedging out took place. J. A. G.

80. One Way of Finding Oil More Cheaply. P. D. Trask. *Oil Gas J.*, 12.11.37, **36** (26), 120–127.—The formation and preservation of a commercial oil-pool depend on the following factors: structure, reservoir, and source beds. Research work carried out on the identification of source material has led to the conclusion that oil is probably derived from organisms such as diatoms, peridineans, copepods and the excreta of the larger marine animals. These materials tend to collect in the basinal areas on the sea floor. Samples of sediments accumulating around the coast of the U.S.A. vary in their organic content from 1 to 7%, but only a small proportion of this material contributes to the formation of oil. The study of oilfield strata leads to the conclusion that a good source bed can be identified by its nitrogen-reduction properties. This is determined by adding chromic acid to the sediment, and, if the latter is deficient in oxygen, a reaction takes place whereby the oxygen given off by the acid combines with other constituents in the sediment. Most of the material concerned in this reaction is organic, and if a large proportion of the chromic acid is reduced, the sediment is said to be favourable, owing to the fact that oil is composed of compounds deficient in oxygen.

This method has been tested in the main oilfield regions of the U.S.A., and the results justify the assumption that it offers a means of identifying possible source beds in other regions. J. A. G.

81. New Data on Clay City and Noble Lime Pays. D. Hager. *Oil Gas J.*, 23.12.37, **36** (32), 22.—Both the Clay City and the Noble fields produce from the McClosky

limestone of Lower Mississippian age. The fields are situated on well-pronounced folds, and the author estimates that they will total about 40 sq. miles in area, with an average production of 8000 brls. per acre from the McClosky alone. The porosity of the latter varies from nil to 40%, and acidizing is generally necessary to complete the wells.

The Chester Sand above the McClosky has shown signs of production in places, and if drilling is carried deeper, the Devonian, Silurian and Ordovician may prove to contain oil on these structures. J. A. G.

82. Deep Pay Formations Underlie Forest City Basin of Kansas. D. Dalrymple. *Oil Gas J.*, 25.11.37, **36** (28), 26–28.—The Forest City basin lies between the Nemaha Granite Ridge and the Chautauqua Arch. A number of wells have been drilled in this area during the last 20 years, but few records of the deeper horizons were kept. Until more coring is done it is impossible to give details of the succession, but it is certain that beds ranging in age from Lower Mississippian to Lower Ordovician are present and contain several horizons known to be productive elsewhere. J. A. G.

83. Large West Virginia Area Underlain by Oriskany. R. C. Lafferty. *Oil Gas J.*, 2.12.37, **36** (29), 17–20.—The Oriskany Sandstone (Devonian) underlies most of West Virginia and has a thickness of about 200 ft. in the north, gradually thinning westwards. In grade size it varies from 1·0 mm. to 0·1 mm., the cementing material being mainly lime, and porosity ranges from 6·8 to 11%. The sandy facies is usually broken in the middle by a few feet of well-cemented sand or shaly limestone, and alternating coarse and fine beds with local cross-bedding in the sand itself indicate that deposition took place in shallow-water conditions.

In Kanawha Co. the Oriskany varies from 11 to 60 ft. in thickness and production comes from the upper 28 ft. Where the thickness exceeds or falls below this average it is usually non-productive. This is probably due to the influence of shore-line conditions during deposition. There are two structural lines in this region, one N.–S. and the other N.E.–S.W. On the latter trend the axes of the anticlines may migrate several miles to the N.W. in depth, but this feature is not so apparent on the N.–S. trend. Seismograph work has indicated that these folds are considerably more faulted and complicated than was at first thought. J. A. G.

84. Occurrence and Accumulation of Oil in Laredo District, Texas. H. H. Cooper. *Bull. Amer. Assoc. Petrol. Geol.*, 1937, **21**, 1422–1438.—The Laredo district, located on the Mexican border, embraces an area 160 miles north and south, by 50 miles wide.

The principal oil-producing sands belong to the Jackson Formation, which is divided into three units: the Whitsett (Fayette) at the top, the McElroy (Hockley), and the Caddell (Diboll). Approximately 95% of the 90,000,000 brls. of the oil produced to date (March 1937) has been obtained from this formation at depths from 750 to 2950 ft.

Production has also been obtained in sands of Yegua age from Bruni (Cole field), located on a closed anticlinal structure, at 3400 ft. Gas and some oil have been encountered in the Carolina–Texas field of Webb Co. and at Roma, Starr Co., whilst commercial gas production has also been procured from the Lopena field, Southern Zapata Co.

Although accumulation is primarily in shore-line sands, the presence of south-eastward plunging folds (approximately parallel with lines of folding in N.E. Mexico and with axes oblique or transverse to the Jackson strand lines) contribute largely to the accumulation of oil along the edges of the respective sand members. This factor is more pronounced in the larger and more extensive fields. G. S. S.

85. Stratigraphy of Western Buchivacoa (Falcón State), Venezuela. G. W. Halse. *Bol. Geol. y Min.* (*Caracas*), April, July and October, 1937, 183–193.—The Quaternary, La Puerta, Cerro Pelado, Agua Clara, San Luis and Eocene strata of Western Buchivacoa are described. The total thickness of the outcropping post-Eocene rocks is 13,000 ft., to which must be added 3500 ft. of Eocene rocks penetrated by the drill.

Rapid variations in the conditions of sedimentation and the absence of marked lithological changes have made the elucidation of the stratigraphy difficult. Detailed correlation with areas outside Western Buchivacoa has not been established.

The paper is illustrated by an index map, four generalized graphic well logs and a diagrammatic section. L. O.

86. General Geology and Stratigraphy of the Cumarebo Region, Falcón State. C. G. de Juana. *Bol. Geol. y Min.* (*Caracas*), April, July and October, 1937, 197–217.—The region of Cumarebo is of particular interest, as it is the locus of marked changes in topography, vegetation and climate, themselves a consequence of geological phenomena.

A brief description of the varied topography and vegetation is given.

Stratigraphically, the area is essentially a zone of transition between littoral and deep-sea conditions. The Recent and Pleistocene beds consist in the main of alluvial and diluvial deposits. The Pliocene is represented by the Coro conglomerates, maximum thickness 500 m., which Liddle placed in the Pleistocene. The Pliocene–Miocene boundary is marked by a discordance of a definitely transgressive character in places.

The Miocene series is definitely marine, except in its upper and lower limits. It is divided into four formations: *La Vela* (average thickness, 600 m.), separated by an unconformity from the *Caujaro* (better known to British geologists as Damsite, 800–900 m. thick), *Socorro* (average thickness 850 m.), and *Cerro Pelado* (total thickness unknown, as its basal contact is masked by alluvium).

The Solito formation (the name is new to literature, but has long been current in private reports) is placed in the upper Oligocene on rather indefinite fossil evidence.

From a regional point of view, the anticlines of La Vela and Cumarebo may be considered as secondary folds in the geosyncline bounded to the north by Paraguaná–Curaçao and to the south by the Sierras of Churuguara and San Luis. The area is divided into separate tectonic units by the N.W.–S.E. fault of La Soledad, to the west of which occur well-defined anticlines and to the east brachianticlines and domes.

Both stratigraphy and structure are dealt with in some detail, and an appendix gives a fairly comprehensive list of the more commonly occurring fossils of Vela de Coro and Cumarebo.

The paper is illustrated by a general map (scale 1 : 100,000), a palæophysiographic map (scale 1 : 500,000), a geological map (scale 1 : 100,000), sections of the La Vela and Cumarebo anticlines, four correlated stratigraphical columns, and a diagrammatic section indicating the phases of sedimentation of the Upper Miocene. L. O.

87. Comparison of the Sedimentary Basins of Maturín and Maracaibo. C. Wiedenmayer. *Bol. Geol. y Min.* (*Caracas*), April, July and October, 1937, 221–250.—The Tertiary basins of Maracaibo and Maturín are responsible for most of the petroleum produced in Venezuela. The former is much better known geologically, but geophysical research has played a more important part in the study of the latter. The Maracaibo Basin has an area of 12,775 sq. km., whilst the estimated area of the Maturín Basin is 68,000 sq. km.

The Maracaibo Basin forms part of a geosyncline which lies mainly to the north of the Andes. It is limited to the north by the igneous rocks of Guajira, Toas, Paraguaná and the Dutch West Indies. The birth of the basin, as a separate unit, occurred in Oligocene times, and its development continued in Middle Miocene and Pliocene times. Petroleum is obtained from formations ranging in age from Cretaceous to Middle Miocene; it occurs in anticlines, domes or the sand lenses or monoclines of low dip. Although the oil has accumulated under littoral conditions, it is rarely found in commercial quantities except near the topographic centre of the basin.

The Maturín Basin forms part of a prominent geosyncline limited to the south by the Brazilian shield. Its northern limit is difficult to establish, but it may coincide with the metamorphic rocks of the Northern Cordillera, or it may be even north of that line. It remained a negative area during most of the Tertiary. The dominant habitat of the Maturín oil cannot, as yet, be forecast. Trinidad produces petroleum from Lower Miocene, and possibly Oligocene, strata in anticlinal structures, although a very small minority of geologists maintain that the oil is mainly of Upper Cretaceous derivation. Quiriquire is the only known important field in the Maturín basin;

its petroleum is found in beds of Pliocene age, to which it has migrated from uncertain sources.

The paper includes a detailed description of the field and historical geology of both basins. L. O.

88. Stratigraphy of the Rio Querecual Section in the North-East of Anzoategui, Venezuela. H. D. Hedberg. *Bol. Geol. y Min.* (*Caracas*), April, July and October, 1937, 253–265.—The stratigraphical column exposed in the Querecual river, about 35 km. E.S.E. from Barcelona, is the most regular and complete section of the Cretaceous and Tertiary strata of N.E. Venezuela known to the author. It should serve admirably as a type section.

In the river and its tributaries about 28,000 ft. of strata are exposed. Added to this, 10,000–15,000 ft. of Miocene and Pliocene beds outcrop to the south of the river section, and 3500–4500 ft. of Lower Cretaceous beds are exposed below the base of the river section. The total thickness of the column is at least 40,000 ft. This column is described in detail, and extensive lithological and palæontological data are given.

The geological history of the area appears to be the result of the interplay of forces between the Guiana shield, an ancient land mass (Paria) to the north, and the Orinoco geosyncline. Deposition has not suffered notable break from Cretaceous to Miocene, except for an abrupt and general positive movement in Eocene times.

The paper is illustrated by a key map, a geological map of the Bergantín-Santa Inés area (approx. scale, 1 : 23,500), and a generalized stratigraphical column.

L. O.

89. Geological Section of the Barinas Region, Venezuela. A. N. Mackenzie. *Bol. Geol. y Min.* (*Caracas*), April, July and October, 1937, 269–283.—The region dealt with is situated on the eastern flanks of the Cordillera of the Venezuelan Andes in the districts Barinas, Bolivar and Obispos of the Barinas State (formerly known as Zamora).

Beds of Cretaceous age and younger are described in detail, and the ages and thicknesses of the various formations are given.

The Third Coal Horizon is missing. The local "El Mene" formation is correlated with Cerro Pelado and is placed, doubtfully, in the Lower Miocene, whilst the local "Transition" beds are correlated with Agua Clara and are placed in the Upper Eocene; these ages differ slightly from those generally accepted for the named formations in fields farther to the north.

The topography and accessibility of the region are described, and the paper includes an outline map of the area, an index map, and a stratigraphical column. L. O.

90. Notes on the Punta Gavilán Formation of the Eastern Region of the Falcón State. H. N. Suter. *Bol. Geol. y Min.* (*Caracas*), April, July and October, 1937, 287–297.—A detailed geological and palæontological description of the Punta Gavilán formation is given. These beds are known also under the names "Veral" and "Punta Zamuro," which should now be rejected. They form the lower part of the Cumarebo formation.

The thickness of the Punta Gavilán formation varies between 30 m. and 150 m., increasing from east to west with gradually decreasing transgression. At Cumarebo they overlie beds of the La Vela formation, whilst at Punta Zamora they contact with beds of the Socorro formation.

All the sediments are typically neritic, shore-line and shallow-water deposits. In age they fall between post-Middle Miocene and pre-Pleistocene, but further palæontological research is necessary to fix their position definitely.

The paper is illustrated by a map (scale, 1 : 200,000) showing the areal distribution of the formation. L. O.

90a. The Great Fossil Mammals of the Barquisimeto Region. H. N. Maria. *Bol. Geol. y Min.* (*Caracas*), April, July and October, 1937, 301–317.—A description of the Toxodont teeth and other fossil remains preserved in the La Salle Institute at Barquisimeto and discovered by the author.

The geographical and geological environment in which the remains were discovered is summarized. The paper is illustrated by a sketch-map, which shows the position

of the fossil localities, a section (scale, 1 : 50) of the excavations at Zanjon de la Represa, and two photographs. L. O.

91. Attock Oil Co.'s Deep Test at Dhulian. Anon. *Petrol. Times*, 13.11.37, **38** (983), 634.—The Dhulian structure is a slightly asymmetric domal anticline with its major axis running E.N.E.–W.S.W. The north dips increase outwards from the axis to a maximum of 50°, whilst the south dips reach a maximum of 30°. Oil, estimated at 800 brls. per day, has been struck in Well "G" at 7653 ft. L. O.

92. Bahrein Island Among Fifteen Largest Oil Producers. Anon. *Oil Gas J.*, 30.12.37, **38** (33), 127–134.—Bahrein Island is about 28 miles long and 10 miles wide, and represents a large closed dome lying in a geosynclinal belt. The surface exposures are mainly of Eocene rocks, with occasional patches of Pleistocene sands and Miocene clays. The Eocene consists of about 1300 ft. of porous limestone with interbedded shale bands, and contains a heavy tar at irregular intervals throughout the section. The upper part of the underlying Cretaceous consists mainly of limestone, chert, shale and anhydrite, and most of the production is obtained from a limestone about 680 ft. below the top of this formation. A series of siltstones and fine-grained sandstones follows, and these are highly productive locally. A third producing horizon occurs at 2700–2800 ft. and a fourth at 4165–4640 ft. So far as is known, the Cretaceous has not yet been completely penetrated.

Production is limited to about 11,000 acres on the crest of the fold. J. A. G.

93. Oil Prospects on the East Margin of the Alps. L. Waagen. *Bohrtech. Z.*, July 1937, 213–214.—The "Grazer Bucht," which is separated from the Hungarian Plain by a buried ridge, has a similar geological history to the Vienna Basin. Both movements commenced in the Lower Miocene and sedimentation, marine, brackish and freshwater, continued into the Pliocene. By analogy with the Vienna Basin, oil and gas deposits should therefore be expected in the Grazer Basin.

The first oil and gas shows in the Graz Basin were found in 1913 to the N.W. of Mureck, near the Austro-Jugoslavian border. These are from a Schlier formation of a probable Tortonian–Sarmatian age. Other shows are found in the innermost corner of the basin. Gas shows were obtained at a depth of 231–242 m. in Middle Miocene beds in a boring at Mooskirchen. The gas proved to be almost pure nitrogen. A third series of shows is found near the buried ridge separating the basin from the Hungarian Plain. Oil and gas have been reported from the Entenwald, the Ameisenwald and Burgau. It has been shown that these shows are in a faulted zone, a fact confirmed by magnetic survey, and not far to the east are two anticlinal structures. The sequence in the area is similar to that at Gbely. S. E. C.

94. Alpine Margin, North of the Danube, and its Significance in Petroleum Geology. M. F. Glaessner. *Petrol. Z.*, 1937, **33** (43), 1–8.—South of the Danube, near Vienna, the outer margin of the Alps is formed by the Flysch zone, which is thrust over the Molasse, but north of the Danube the outer "Klippenzone" occurs between the Flysch and Molasse. The significance of this zone lies in the fact that it shows on the one hand the bottom of the Molasse and on the other the Flysch. This is a matter of great importance from the point of view of prospecting in the Molasse and Flysch zones of Lower Austria.

The oldest rocks in this zone are Jurassic (Leiser Series), and belong to two facies, calcareous marls and white, corallian limestones. Then follow Upper Turonian, Upper Senonian, Danian, Eocene and Oligocene. Until the Upper Senonian the zone formed part of the Bohemian massif. Transgression over the separating ridge then took place, and the deposits took on an Alpine–Carpathian character, but still retained certain peculiarities.

The tectonic development of this outer "Klippenzone" began in the Oligocene and ended with the thrusting of the outer margin over the Middle Miocene Schlier. It is essentially a schuppen structure.

From the detailed study of the stratigraphy it is concluded that the Flysch oil probably came from the Oligocene in the Waschberg–Nikolsburg zone, and that therefore a detailed study of the boundary between the Flysch and the outer Klip-

penzone is important. Accumulation of oil in the Klippenzone is possible in Oligocene sand lenses and in thrust blocks of older sandstones. It is possible that the Oligocene clays extend beyond this region, under the Miocene Schlier of the Molasse zone, and search should be made for suitable structures. S. E. C.

95. Zistersdorf (Austria) Crude and its Origin. K. Friedl. *Bohrtech. Z.*, June 1937, 147–157.—The most important formation in the Zistersdorf field is the Sarmatian which lies below a thick cover of Pannonian and dips in a S.E. direction. To the N.W. it is brought into contact with Cretaceous Flysch by the eastern Steinberg fault. Twelve oil horizons have been proved in the Sarmatian. The lowermost Sarmatian and the underlying Tortonian have not yet been reached, so that the possibility of finding new oil horizons still remains. The other producing formation is the Flysch. In contrast to the Sarmatian, where the oil has undoubtedly accumulated in the pores of sands, the Flysch oil comes from fissures.

The crudes from the first seven Sarmatian horizons are practically identical and are typical naphthenic oils. The crudes from the lower horizons are a mixed paraffinous–naphthenic type. Two types of crude are also obtained from the Flysch, that from the highest level being very similar to the Sarmatian naphthenic crude and that from the lower level being a mixed type.

There are three possible sources of the Zistersdorf crude: the Flysch, the underlying Schlier, or the Sarmatian. Whilst it is possible to argue in favour of the first two, a Sarmatian origin satisfies all the observed phenomena, and is therefore supported by the author. The Flysch crude has migrated from the Sarmatian. The necessary conditions for the accumulation and conservation of large quantities of organic matter were present in the Vienna Basin during Upper Miocene times. During compaction the oil which was formed then passed from the finer sediments into the coarser, and finally accumulated in the higher parts of the structure. The absence of oil, except for small impregnations due to secondary migration, above the Upper Sarmatian is due to the change from brackish to fresh-water conditions.

In discussing the relationship of naphthenic and paraffinous crudes, the theories that the naphthenic is derived from the paraffinous or that both have separate origins are rejected. The difficulty in the theory that the paraffinous crude is derived from the naphthenic lies in the fact that in normal hydrogenation higher temperatures are required than would be obtained in nature and, furthermore, hydrogen has to be supplied. This difficulty, however, is overcome by invoking bacterial action, which takes place above a certain minimum temperature. Thus the shallower oil remains naphthenic in character, whilst the deeper tends to become paraffinous. Both types migrate and, as the action is irreversible, it is therefore possible to find paraffinous crudes also in relatively shallow positions. S. E. C.

93. Petroleum in South Germany. R. Schreiter. *Bohrtech. Z.*, June 1937, 134–144.—After a brief mention of the occurrence of bitumen and bituminous rocks in South Germany, the petroliferous areas are described in some detail. Those in the Rhine Graben, from north to south, are the foreland of the Odenwald, North Baden, Pechelbronn (not described here as it is in French territory), the Bienwald, and the extreme south part of the graben, which also includes some French and Swiss territory. In addition there is the Alpine foreland zone.

In the Odenwald foreland wells in the neighbourhood of Heidelberg have given shows of oil and asphalt at depths of 700–800 m. Small quantities of oil have been obtained at Laudenbach, Seckenheim and Heppenheim. A number of shallow and deep wells have been located in Baden and Hesse.

The structure in North Baden is due to block faulting. Shallow and deep drilling have thrown much light on both stratigraphy and structure. In the Bruchsal district upper, middle and lower fault blocks may be distinguished. The Jurassic area around Langenbrücken belongs to the upper block. The development of the Lower Oligocene in Baden often deviates from that at Pechelbronn, but the Upper Eocene is the same in both localities. The most important oil horizon is the Limnæa Marls (Eocene). Others are found in the Meletta Beds (Middle Oligocene) and the Murchisonæ Beds. Possible source rocks include the Posidonian Shales, the Limnæ Marls, and the Grey Series (Middle–Upper Oligocene).

In an attempt to prove a continuation of the Pechelbronn field, wells have been drilled in the Bienwald. A gentle anticlinal structure was found, but nothing more than traces of oil and gas have been obtained.

In the German part of the southern end of the Rhine Graben the search for oil was mainly rewarded by the discovery of potash deposits.

Possibilities in the Alpine foreland are very difficult to assess, on account of the very complicated tectonics. The Tegernsee occurrences are found in this area, and the various theories concerning the origin of the oil are summarized.

Details are given of production and also analyses of typical crudes. S. E. C.

97. Oilfields of the U.S.S.R. W. J. Kemnitzer. *Oil Gas J.*, 30.12.37, **36** (33), 72, 73, 303–304; 13.1.38, **36** (35), 37–38, 42.—The Emba Basin represents an old inland sea and is covered in many places by Quaternary deposits, although Tertiary and Cretaceous both outcrop. In the northern part of the basin the Mesozoic is gently folded in an E.–W. direction, and in the Emba River area there are a number of domes which contain beds of salt and gypsum. Towards the S.W., near the Ural River delta, the folding becomes much sharper, but approaching the Ust-Urt Plateau in the S.E. the beds are less disturbed. The oilfields in this region are divided into the northern and southern zones. The latter includes the fields of Dossar and Makat, which are the largest producers. Production is obtained at an average depth of 750 ft. from the Lower Cretaceous or Upper Jurassic sands, but the oil may have had a deeper origin and migrated up the numerous faults.

The Lower Volga and Kalmyk–Salsk region lies west of the Ural River and extends north of the Caspian Sea to the Caucasus Mountains. It contains no oilfields, but is considered to be favourable territory, and the presence of salt-domes is expected west of the Volga delta.

The Ural region situated north of the Emba–Volga area, between the Volga River and the Ural Mountains, is a large Permian Basin underlain by Palæozoic and Archæozoic rocks. Most of the oil is found in structures which probably overlie old land surfaces or limestone reefs. Only three fields are developed here, but deep prospecting is expected to discover many more. Production is mainly from limestones in the Lower Permian, but the Carboniferous and Devonian are also oil-bearing.

The Ishimævo field in the Bashkir district of the south-central Ural area is developed in Upper Carboniferous limestones. The latter are probably remnants of an old eroded land surface or reef deposits, and are overlain by a very horizontal Permian series. There is only one small field in the Samarskaya Luka district to the S.W. of Bashkir. Production is from two sandy horizons in the Carboniferous at depths of 2040 ft. and 3000 ft. The structure is a gentle uplift truncated on the northern side by the Jiguli flexure.

The Central Asia Region is divided into three areas. The Turkmen district S.E. of the Caspian lies in a structural depression between the North Persian Mountains and the Mesozoic Range. Within the basin Tertiary beds are folded in a N.W.–S.E. direction. The Neftedag field is situated on a faulted dome trending E.–W. and produces from the Pliocene at a depth of from 400 to 600 ft. Cheleken Island is also a faulted dome trending E.N.E.–W.S.W., oil being obtained at depths varying from 30 to 850 ft. in Miocene sands.

The districts of S. Uzbek and S. Tadjik, north of the Afghanistan border, contain proved oil zones in the Middle Jurassic and Palæozoic. These are overlain by a comparatively thin series of Mesozoic and Tertiary sediments which form a series of N.N.E.–S.S.W. ridges separated by narrow alluvial valleys. The Ferghana Basin contains Cretaceous and Tertiary beds folded in an E.–W. direction. Oil has been discovered in the Eocene, Cretaceous and Oligocene beds.

Apart from the Pliocene production obtained in the northern part of Sakhalin Island, no important discoveries have been made in the Far East Region. Jurassic, Cretaceous and Tertiary sediments, however, are well developed along the coastal areas, and these contain numerous indications of oil. J. A. G.

Geophysics.

98. Magnetometer has Many Uses in Geophysical Exploration. K. H. Schmidt. *Oil Gas J.*, 2.12.37, **36** (29), 15–16.—The choice of a geophysical method depends

on the following considerations: (1) purpose of the survey; (2) geology of the area; (3) economic factors. For general reconnaissance, having regard to the elements of economy and speed, the logical rating is (1) magnetic, (2) gravity, (3) seismic (the electrical method is omitted from this discussion). In detailed work the geological conditions constitute the first determining element, but since areas investigated by geophysics usually offer little geological information, the choice may be difficult. The economic factor gives the order magnetic, gravity, seismic, but under certain geological conditions the question of definiteness of information may reverse this order of preference of methods. The ideal sequence of beds for seismic work is mainly that the density of the beds should increase with depth. The success of the gravity method depends on the effect of structural conditions on the gravity field. The intensity of the magnetic field is determined by the susceptibility of the sediments or the configuration of the basement rocks. The small magnetic anomalies caused by uplifts, faulting and thinning of beds can be located when the proper field procedure is used; the larger anomalies dependent on the conditions of the basement rock and igneous intrusions, and the corresponding sedimentary uplifts, are easily found and interpreted. On the Edwards plateau in West Texas a thick limestone lies at the surface, rendering seismic work impracticable due to its high velocity of transmission of seismic waves. There magnetic anomalies correspond well with structure. Undoubtedly the basement is the controlling feature.

The magnetic method is speedy in operation and rates high in respect of economy. It has had a large number of successes, and is being used more in the U.S.A.

G. D. H.

99. Recent Advances in Geophysical Prospecting. H. Lundberg. *Canad. Min. metall. Bull.*, 1937, (308), 758–788.—Describes briefly the history of geophysical prospecting since its inception, and the record of recent work in connection with Canadian metalliferous deposits. Results of magnetic and electrical determinations of contacts, dykes, quartz veins and sulphide ores are cited, in addition to examples of bedrock contouring beneath overburden by means of ratiograph surveys. D. W.

100. Unusual Problems Present in Seismograph Work Abroad. J. L. Adler. *Oil Gas J.*, 30.12.37, **36** (33), 75, 302–303.—The reflection seismograph has been applied to certain oilfields in Europe and Asia where complex structures—overthrusts, fanfolds, nappes, etc.—occur, but the successful interpretations are dependent on the large amount of additional information made available to the geophysicist. It is only natural that the first drilling should have taken place in such areas where the outcrops permit the interpretation of the structure and seeps reveal oil. Bordering these areas are flatter lands where younger deposits, lying nearly horizontal, conceal the structure of the oil-bearing beds. The structure of the latter may be expected to be simpler than nearer the mountains, and will be more amenable to reflection seismograph work.

In many foreign countries problems arise with regard to transport, food and water supply, and labour. Geophysical work requires more equipment than a geological survey. The shooting and recording apparatus have been reduced in size and weight so as to be transportable by hand. The equipment for drilling shot holes presents more difficulty, but in some areas this problem can be solved by hand-drilled holes or the use of small motor-driven augers.

There has been a tendency to make too elaborate arrangements for camps, but wise choice, with due consideration as to the period of duration of the work at any spot, will eliminate undue expense and other difficulties in this direction.

G. D. H.

101. Radio Prospecting. The Propagation of Hertzian Waves in Rock Masses. V. Fritsch. *Beitr. angew. Geophys.*, 1937, **6** (3), 277–306.—The scope of this paper is illustrated by a problem in which the sending station is at the earth's surface and the receiving station in a mine. There are three possible paths for the waves: direct through the normal rock, along the surface and down the mine entrance, or along a vein, lode, or fault which extends from the mine to the surface. These various conditions are discussed and their effect on the propagation of the waves is analysed. The first

important consideration is a proper understanding of the "geological conductor," and it is dealt with in some detail. From the electrical viewpoint it may be taken as a framework of first- and second-order conductors in which capacity is very important. The knowledge so obtained of the geological conductor is then applied and equations are developed for the propagation of the waves.

The final part of the paper deals with experimental work in various parts of Czechoslovakia. The results of this work are as follows. Hertzian waves can penetrate several hundred metres into rock, but their range depends not only on the thickness of rock, but also on a number of other factors, prominent amongst which are geological structure and hydrology. Absorption depends largely on frequency. The experiments show that for wave-lengths to 60 m. Petrowsky's frequency relationship holds good, but that for wave-lengths of 40 and 20 m. other absorption maxima are found.

S. E. C.

102. Radio Prospecting. Investigations in the Application of Radio Prospecting by the Capacity Method. V. Fritsch. *Beitr. angew. Geophys.*, 1937, **7** (1), 53–67.—Descriptions of investigations by this method in the Kotterbach mine, Czechoslovakia, have already been published. In the present paper the design of the apparatus is discussed and a number of suitable antennæ are described. The various inaccuracies which may arise and the manner in which corrections may be applied are indicated. Some antennæ–capacity curves and examples of lines of equal capacity are given.

S. E. C.

103. Tectonic Investigations by Quantitative Electrode Method. J. B. Ostermeier. *Bohrtech. Z.*, June 1937, 158–164.—Whilst the methods of prospecting which give horizontal variations in conductivity of the strata are of value in oil prospecting, it is even more important to trace the lithological boundaries, to determine the physical properties of the rocks, and, in the case of approximately horizontal strata, to determine exactly the depths of the boundaries at various points. This may be effected by the use of various combinations of electrodes and variations in their relative disposition. A.C., D.C., or intermittent D.C. may be used. When using A.C. or intermittent D.C., the frequency should be kept as low as possible, and non-polarizing electrodes are necessary. Heavy dry batteries with an E.M.F. of several hundred volts and capable of giving currents up to 1 amp. are used for D.C. work. P.D.'s between electrodes are measured by the null method.

Measurements may be made for great depths, but in general in oilfield practice it is sufficient to be able to trace marker horizons down to depths of 1000 m. Whilst A.C. may, if desired, be used for depths down to 1500 m., D.C. should be used for greater depths.

The error in resistance measurements down to depths of 1000 m. is of the order of 1–3%. The depths of the boundaries between various strata may be determined with an average error of 3–5%.

S. E. C.

104. Geothermal Measurements in Mines. J. G. Koenigsberger. *Beitr. angew. Geophys.*, 1937, **7** (1), 68–83.—The results of geothermal measurements since 1910 are reviewed and a summary is given of the geothermal gradients in various rocks and structures. Temperatures in mines are generally less than those in boreholes in similar conditions. The causes of this are various, but probably the most important is the cooling effect of natural and artificial ventilation. Temperature measurements should be made in boreholes located about 1 km. from large mines, and compared with the temperatures in the mines in order to throw some light on this problem.

S. E. C.

105. Influence of the Mud Column in a Borehole on the Apparent Resistance. J. N. Hummel and O. Rülke. *Beitr. angew. Geophys.*, 1937, **6** (3), 265–270.—The possibility of mud affecting resistance measurements in a borehole is discussed. The mathematical treatment is based on a consideration of a cylinder of infinite length embedded in a boundless medium. The conclusions reached are that the mud has only a small effect on the results obtained in thick strata, and that only in rare instances need corrections be applied.

S. E. C.

106. Geological Interpretation of Geophysical Measurements. J. Schander. *Bohrtech. Z.*, June 1937, 164–165.—Owing to the intensive development and application of geophysics, all the obvious structures in certain parts of America, *e.g.* the Gulf Coast, will be found and drilled. The tendency therefore in that area is towards an analysis of anomalies which have hitherto been unexplained, and which apparently are not salt-dome effects. There are limits in the interpretation of such anomalies. The accuracy of the interpretation depends on the geophysicist's knowledge of the stratigraphy and tectonics of the region. In completely unknown areas a test boring is necessary to throw light on those points. Where that cannot be obtained the geophysicist should limit himself to giving the results of his measurements. The final test of any theory is the drill, and much valuable experience is to be obtained by reviewing geophysical evidence in the light of a later drilling programme.

S. E. C.

107. Geometrical Solution of the Basic Problems of Applied Seismics. A. Berroth. *Zeit. Geophys.*, 1937, **13** (2/3), 87–106.—Hitherto interpretation of seismic work has been based on time–distance curves. These curves take the form of simple polygons for all refracted rays in the case of homogeneous and isotropic strata. In the absence of homogeneity and isotropism, the polygons become various types of curves, with the result that in such a case a satisfactory solution by this method cannot be obtained. With the reflection method an explanation of the nature of the time–distance curves hitherto has not yet been published. The simplest problem involves a curve of the second order, and the complexity of the curve increases with the number of the strata. The only case when a straight-line time–distance curve is obtained with the reflection method is that of perpendicular reflection.

These curves are analysed, the work being divided into two sections. The first deals with the reflection of elastic waves, and the second with their refraction. In each case the problem is considered from the point of view of one, two and more than two lithological boundaries.

In the refraction method the tangents to the apparent velocity curves coincide with the time–distance curves. For exact results only a small portion of the curves are used. The difficulties in the rigorous treatment of results from the reflection method are due to the fact that in this case the apparent velocity alters its direction from point to point.

S. E. C.

108. Direct Method for the Interpretation of Gravity Anomalies. K. Jung. *Zeit. Geophys.*, 1937, **13** (2/3), 45–67.—In the indirect method of interpretation a distribution of mass which gives effects approximating to the observed values is found by trial and error. This method can be applied in all cases, and when conditions are not too complicated it is rapid, but it depends on the skill and experience of the worker. In the direct method it is assumed that the distribution of mass follows a simple geometrical form for the exact determination of which two, three or four form-characteristics are sufficient. The magnitude of these may be determined by calculation, graphically, or from tables.

This direct method may be applied when the anomalous mass has a simple geometrical form, or when knowledge of the gravitational field is insufficient to give greater detail. It is also of value in supplying a good approximate solution for use with the indirect method. Whilst the gravity gradient map is often so complicated by local surface disturbances that interpretation is extremely slow and difficult, the isogams and δg curves obtained from measurements of gravity itself are much smoother, and the position and magnitude of the maximum and half values of the gravity anomaly, the gradient and the integral may be determined with some exactitude.

The theoretical treatment of various simple forms is given and their characteristics are tabulated. The application of the method is illustrated by two examples.

S. E. C.

109. Instrument to Simplify Gravity Calculations. N. Szecsödy and J. Renner. *Beitr. angew. Geophys.*, 1937, **6** (3), 307–310.—The instrument is designed to give the gravitational effect of a two-dimensional mass. It consists of a protractor, graduated in radians, to which is fixed a long logarithmic scale. A second logarithmic scale is

pivoted at the centre of the protractor. Values of gradient and curvature are easily obtained and a number of examples are given to illustrate the mode of operation.
S. E. C.

110. Geophysical Interpretations. M. S. Blackburn. *Oil Wkly.*, 3.1.38, **88** (4), 15.—Regardless of the method used, the value of geophysical investigations depends not altogether on the accuracy of the instruments (assuming they are the best available), but almost entirely on the ability of the interpreter. Sometimes it is possible to infer two different pictures from the field data, both equally valid from an interpretative standpoint. The value of geophysical work is greatly enhanced by taking cognisance of geological data which assist in the selection of the correct picture.

Each geophysical method has its good points: some can give greater detail than others, but are slower and more expensive; some work better than others in certain regions. A combination of methods may be used to great advantage, *e.g.* fast instruments, which can locate structure, but cannot tell depth, could be used for reconnaissance work, and their findings checked later by a depth-measuring method.
G. D. H.

111. Locating Water Source is Initial Step in Making Well Repairs. C. R. Dale and H. Guyod. *Oil Gas J.*, 18.11.37, **36** (27), 66.—The water cut in California oilfields during 1936, as a whole, amounted to 43·97%, and records kept in many individual fields show that it ranges from 40 to 90%, and indicate that it is increasing yearly.

The problem of reducing the water cut is not a new one, but the fundamental handicap has, in the past, been the lack of accurate information as to the point or points at which the formation water was entering the well. Modern oil-well water locating service is available and greater success is being obtained in repair work.

A great deal of money can be saved if the point of entry is determined and the well repaired when the intrusion of formation water first takes place.

Photoelectric water-locating surveys are enabling the source of the formation water to be located accurately and swiftly.

Methods of repairing wells in the older fields where accurate information is lacking are described.
L. V. W. C.

Drilling.

112. Developments in Modern Cable-Tool Drilling. L. H. Towers. *Petrol. Engr.*, Dec. 1937, **9** (3), 35.—Decided improvements have been made in the entire range of equipment used in cable-tool drilling from the smallest spudding unit to the largest standard rig.

Increased portability of all types of units is noticeable, spudders have been developed and an increase in the use of internal combustion engines as prime movers has occurred. Unitization of several types of drilling machines to facilitate rigging-up, the combination of cable and rotary operations, improved fishing tools, and drilling bits, use of whipstocks and of colloidal mud behind casing are other developments in this newer equipment.

For shallow work in water-drive areas, spudders are generally used, since these units afford economy by full, rapid removal to new locations, etc.

Multi-cylinder gas engines are employed as power units in most rigs, but a few are still driven by steam engines. Drilling tools have not changed and a 650 ft. manilla cable is used on the bottom of the wire line.

70 to 110 days are required to complete 5000 ft. wells which produce 5,000,000 to 25,000,000 cu. ft. of gas daily.
L. V. W. C.

113. Marine Drilling. A. J. Ruthven-Murray. *J. Instn. Petrol. Tech.*, 1937, **23**, 760–770.—A lecture with discussion at the Trinidad branch on the methods employed at Elwood, California, Lake Maracaibo, Venezuela, and Black Bayou, Louisiana to carry out marine drilling and the application of the experience gained to the coastal waters of Trinidad.
G. R. N.

114. Trends in Design of Drilling Equipment. Anon. *World Petrol.*, 1937, **8** (6), 74.—A review of modern drilling equipment covering boiler feed-water heaters,

superheaters, individual steam-engine drives to slush pumps and rotary table—these engines arranged for coupling together for operating the draw-works and designed to use superheated steam expansively—diesel engine and diesel-electric power units, portable rigs, pressure-drilling equipment, heavy slush pumps and draw-works, rotary feed control, and drill-pipe threads, all of which increase the efficiency and speed of drilling. W. W.

115. Progress in the Use of Alloy Steel for Deep Drilling. Anon. *World Petrol.*, 1937, **8** (6), 92.—Short article outlining the use of molybdenum, chromium and nickel in producing alloy steels for the manufacture of drilling tools and equipment suitable for deep drilling. W. W.

116. Formulæ for Calculating Drill-Pipe and Casing Collapse Point. Mannesmann-röhren-Werke. *World Petrol.*, 1937, **8** (6), 90.—The Mannesmannröhren-Werke arrived quite recently at two improved formulæ relative to the critical external pressure range, and they examined their applicability by running extensive check tests. These formulæ are given, together with relative graph and some examples of application. The formulæ take into consideration the yield point of the material and offer a valuable means of eliminating dangerous factors of unreliability in deciding on dimensions of coupled drill-pipe and casing sections to be used under various conditions. W. W.

117. Drill-Pipe Failures. J. E. Brantly. *World Petrol.*, 1937, **8** (6), 67.—The types of failure of drill-pipe are discussed, together with factors responsible. Faulty design is at present the main cause of drill-pipe failure, and it is obvious that with the greater depths now being penetrated, drilling shafts capable of withstanding much greater stresses and labour than existing shafts are necessary. Some improvements are suggested. W. W.

118. Improved Cementing by Two-Period Squeeze Method. Anon. *World Petrol.*, 1937, **8** (6), 78.—This method is designed to correct the deficiencies of the usual single-stage cementing method. Cements of two different characters are required, one of which will take its initial set in about two hours or slightly more, and another that will take its initial set in not less than six hours, and remain pumpable for at least four or five hours. A hypothetical case of applying the method is described. W. W.

119. Molten Sulphur—An Experimental Circulating Fluid. Anon. *World Petrol.*, 1937, **8** (3), 46.—The possibilities of sulphur as a drilling fluid are discussed. A test-well has been drilled at Boling Dome, Texas, using molten sulphur as the circulating fluid. Eight-inch casing was set with "frozen" sulphur as cement, and the casing was subsequently recovered by re-heating the cement. As a circulating medium sulphur appears to offer a solution to the operating problems presented by heaving shale and unconsolidated formations. W. W.

120. Ground Oyster Shells Proving Valuable in Drilling Muds. T. P. Sanders. *Oil Gas J.*, 25.11.37, **36** (28), 54.—Oyster shells and calcareous vesicles of other sea urchins have been used, in pulverized form, as an admixture for drilling fluids. The addition of calcium carbonate makes drilling mud susceptible to attack by HCl, and this characteristic becomes important in well completion and fishing jobs.

Calcareous drilling fluid is one of the remedies advanced to meet the problem of drilling through an oil-bearing formation without impairing its productivity.

About 100 lb. of calcium carbonate have been added to each barrel of mud and about 5000 gallons of acid are used.

In California crushed shells provide the calcium carbonate, and the method of preparing and applying the subsequent mud is described. L. V. W. C.

Production.

121. Water-Flooding Methods in the Mid-Continent. L. E. Smith. *Nat. Petrol. News*, 10.3.37, **29** (10), 73.—A recent estimate indicated that approximately 1200 acres of oil territory in N.E. Oklahoma and Southern Kansas were under development for flooding. The total daily average oil production from these properties during January was 2500 brls., of which 50% was being obtained from one project. The author believes that this secondary method of oil recovery, relatively new to the Mid-Continent, will gain impetus during 1937. The principal water-flooding projects under way in the area are briefly described and details as to production for the most outstanding one are given. One of the most difficult problems which confronts water-flooding operators in the Mid-Continent is that of adequate water supply.
W. W.

122. Gas-Lock Conditions in Pumping Wells. R. H. McLemoae. *Oil Wkly.*, 29.11.37, **87** (12), 17.—The tendency of wells to gas-lock before the daily allowable has been produced has been a problem that has bothered operators in areas where the production must be obtained by pumping. This condition is brought about by the accumulation of free gas in the casing, which lowers the fluid level below the tubing perforations and allows the gas to collect in the working barrel.

The minimum amount of gas that must be released in order to get the day's production must be determined. To do this the necessary quantity of gas should be released at as small a rate as possible, over as long a period of time as possible. The bleed-off arrangement should be adjusted so that the gas is released through a constant size opening over the 24-hr. period. This bleed-off arrangement is made on a well that is pumped 24 hrs. daily by installing a valve or pit cock on the line going to the flow line from the casing-head and by adjusting the rate of bleed-off so that a pressure a few pounds lower than that pressure at which the well will gas-lock is held on the casing.

The procedure of determining the correct minimum quantity to be bled-off from the wells is given.
L. V. W. C.

123. Oklahoma City Field Pumping. B. M. Moroney and F. R. Wheeler. *Oil Gas J.*, 12.11.37, **36** (26), 115; *Petrol. Engr.*, Nov. 1937, **9** (2), 105.—In cases of low rates of flow, hydraulic and sucker-rod pumping are in direct competition with one another, but with high rates of flow the centrifugal pump is superior. As far as cost per barrel is concerned, there is little actual difference, in general, in the three pumping methods, hydraulic, sucker rod and centrifugal.

Advantages are shown for each of these methods, and these are given in detail, and the problems and results of each are discussed.
L. V. W. C.

124. Pumping Slant Holes at Huntington Beach. D. K. Weaver. *Petrol. World* (LA), 1937, **34** (6), 46.—An A.P.I. paper presented at the Mid-Year Meeting of the A.P.I. at Colorado Springs, June 3rd, to show that the inclined wells at Huntington Beach can be and are being pumped, and that the producing cost is not excessive. The paper outlines the numerous problems which have arisen and the various corrective measures which have been taken.
W. W.

125. Van Pool Being Developed Scientifically Throughout All Stages of Production. M. Tucker. *Oil Gas J.*, 25.11.37, **36** (28), 44.—The development and operation under unit control of the Van oilfield of Eastern Texas is outstanding, particularly with respect to recovery, pressure maintenance and low development and operating costs.

The discovery well at Van was drilled and completed in October 1929, after an intensive seismic and core-drill exploration. Five leaseholders completed unitization in November 1929, and the manner of allocation is described.

The acre–foot factor in proration formulæ has been established at Van as a practical and effective means of providing equity among all the producers concerned.

The pressure decline in the brown sand wells has been only about 90 lb. during the 8-year life of the field, whilst in the bentonite section an irregular and more rapid decline has been exhibited.

Gas–oil ratio is approx. 325 cub. ft. of gas per barrel of oil, which is practically the same as at the time the field was discovered. L. V. W. C.

126. Deep Wells Producing Under High Pressure Efficiently Controlled. D. S. Sneigr. *Petrol. Engr.*, Dec. 1937, **9** (3), 38.—Several noteworthy improvements have been made in the production equipment in Brazoria County, Texas, resulting in greater efficiency.

The Christmas-tree assembly now in general use in the field consists primarily of six chokes and several gate values of 10,000 lb. test. The flow of oil and gas can be directed from either or both wings of the flowhead. The pressure is reduced in three stages from approximately 4000 lb. to the working pressure of the separators.

Heaters, separators, tanks and power plant are centrally placed.

Special methods have been successfully applied, and increased efficiency of well operation has been obtained, together with improved flexibility of control.

Wells are spaced 1320 ft. apart, and the casing programme provides that three strings of pipe must be set in each well. The surface casing must be new pipe of 1200 lb. test, the second string must be tested to 2100 lb. and the set at not less than 6500 ft. The oil string must be of 2600 lb. test and the Christmas tree must stand 10,000 lb. test. L. V. W. C.

127. Controlling a High-Pressure Gas Well in Otis Field, Kansas. Anon. *Petrol. Engr.*, Dec. 1937, **9** (3), 102.—A high-pressure gas well in the Otis field, Kansas, had to be brought under control. The well had been killed with water and then bailed down until the gas pressure exceeded that of the water so that it began to empty of its own accord. An effort was made to lower a bit into the hole and to fasten the oil saver in the top of the control head. It was found that the pressure was too great and impossible to seat the oil saver on the packing ring. The drilling line was severed by the cutting action of the gas, sand and water, the bit dropped into the casing and the oil saver was blown into the derrick. The bit was eventually recovered and the well was later killed and the bit lowered into the hole before too much of the water escaped.

The well was producing 60,000,000 cu. ft. of gas and the pressure was 950 lb. L. V. W. C.

128. Oil-Well Performance. B. P. Kantzer and E. G. Trostel. *Oil Gas J.*, 12.11.37, **36** (26), 111.—General terms of indefinite meaning have been evolved during the development of well performance studies. An effort has been made to limit these terms by the introduction of specific definitions. New terms have been included to describe adequately the general subject of oil-well performance, and it is considered that clearness will be facilitated if standards are adopted while the subject is still in a formative stage. L. V. W. C.

129. Loading Explosive into Wells by Pressure Aids Production. F. R. Cozzens. *Oil Wkly.*, 29.11.37, **87** (12), 44.—Producing sands, regardless of depth or texture, contain numerous fissures, seams and soft spots, and when a shell of explosives is lowered to the bottom of the well in the usual manner, these fissures remain empty or only partly filled with fluid. When detonation takes place these cavities absorb concussion, thus reducing pressure upon the rock, and since the force within the cavity is always directed outwards the fluid is thus forced farther away from the hole.

To remedy this condition, operators have made a practice of dumping a quantity of liquid explosive into the well before placing the shell. A far better method, and one that is coming to the front in shallow sand districts, is to force explosives into the rock by outride pressure. The explosive is lowered to the bottom of the hole, and a cap is pushed down upon the charge. A quantity of water is next poured down to serve as an anchor and a 2-in. air line is then connected to an air compressor, and air forced down until pressure at the casing-head registers 800 to 1000 lb. The pressure is then released, connections are removed and the charge is fired electrically. The air and water force the explosive material into all the openings along the sand face, and results in a more uniform pressure and better rock breakage. L. V. W. C.

130. Gravel-Packing Oil Wells. Part I. W. A. Sawdon. *Petrol. Engr.*, Dec. 1937, **9** (3), 83.—Serious attention has been given to the possibilities of placing a gravel wall around the oil string or liner in wells in California as a means of eliminating sand trouble where the producing formations are known to cause trouble from excessive sanding. An effort is made to reduce the infiltration of sand into the hole and to protect the walls of the well during its producing life.

Methods of placing the gravel vary in detail and in general principle. There is the reverse circulation method in which the gravel is injected between the casing and tubing, and the normal circulation method, in which the gravel is pumped down inside the tubing, the fluid returning between the tubing and casing.

L. V. W. C.

131. Prevention of Oilfield Emulsions. J. S. Surfluh. *Oil Gas J.*, 12.11.37, **36** (26), 105; *Petrol. Engr.*, Nov. 1937, **9** (2), 100.—Practical results obtained in California in oilfield treating of emulsions are dealt with.

The causes and sources of emulsions and their prevention are considered in detail, and descriptions of various types of pumps for the injection of the chemical into the wells are given. L. V. W. C.

132. Control and Disposal of Salt Water in the Talco Field. M. Tucker. *Oil Gas J.*, 18.11.37, **36** (27), 46.—Salt water is undoubtedly the Talco field's most serious problem and requires attention from four different angles. Reconditioning of wells in order to retard encroachment of flank water; problems arising from the lifting of large water volumes; difficult treating problems; and the disposal of the water.

A large portion of the water is at present being pumped back into the casing-head of the oil wells and discharged back into a highly porous and thick water sand. Consideration is now being given to the drilling of one or more large-diameter salt-water injection wells.

Water production is being minimized by reworking, squeezing, or setting short casing strings. In some cases operators are shutting-off thick oil-bearing sands in order to reduce water volumes.

The lifting problem includes high polish-rod loads for some of the units employed, sulphur corrosion, caving formations, frequent well servicing, high fuel costs, etc. Wells making appreciable volumes of water must be handled at a cycle which will minimize coning or by-passing of the water up through the oil column while pumping. Pumping rate has its effect upon the tightening of the oil–water emulsion.

L. V. W. C.

133. Applied Back Pressure as an Agent in Control of Paraffin. F. B. Taylor. *Oil Wkly.*, 6.12.37, **87** (13), 18.—As a means of retarding paraffin formation controlled back-pressure has been found effective in Texas Panhandle wells. Pumping wells have been equipped with pressure manifolds and with very little attention a partial control has been possible over the inter-tubing formation of produced paraffin. The installation is simple, but there are limitations to its application. It is not a cure-all, but a strong case can be made out for it when at one pumping well continuous operation has been carried on for 10 months without a paraffin job, whereas prior to the installation of the back-pressure equipment a clean-out job was necessary every 60 days.

The manifold is a simple gate-operated by-pass cut directly into the production lead line, and the few parts necessary are mainly in stock on every lease.

The running of this method is described. L. V. W. C.

134. Quick Reversals in Acid Treatment of Oil Wells. M. E. Chapman. *Petrol. Engr.*, Dec. 1937, **9** (3), 106.—The practice of quick reversals or rapid withdrawals of solution in connection with acid treatment of wells is steadily gaining favour in the Mid-Continent area.

It has been found that acid-treating produces better results if the flow is quickly reversed and the closed-in period reduced, even though some unspent acid may be brought to the surface and wasted. If the treatment continues long enough to neutralize the acid completely, reaction products and residues may partly clog the production zone and reduce the value of the treatment. L. V. W. C.

See also Abstract No. 111.

Transport and Storage.

135. Automatic Shut-off Valves Exclude Air from Oil-Gathering Systems. Anon. *Oil Gas J.*, 2.12.37, **36** (29), 41.—An automatic shut-off valve has been designed to exclude air from pipe-line gathering systems. Fifty of these valves have been installed on the gathering system of one major company in the Keskuk field, Okla.

The main feature of the valve is a chamber containing a float connected with a valve in the gathering line. The float is lowered, as a result of air in the line entering the float chamber, closing the valve immediately. The valve remains closed until the vacuum is broken by the release of air from the float chamber and resetting of the valve is quickly accomplished. L. V. W. C.

136. Ground Beds for Use in Cathodically Protecting Buried Pipe-Lines. S. U. McGary. *Petrol. Engr.*, Dec. 1937, **9** (3), 96.—In order to maintain the voltage required in the installation for cathodic protection of pipe-lines, it is necessary to regulate the wire resistance and the contact resistance between the ground bed and the surrounding soil, as the resistance of the ground bed and the pipe-line cannot be altered or controlled. For the wire large gauge (4/0 or even larger) is used. The greatest loss of energy is in overcoming the resistance of contact between ground-bed pipes and the surrounding soil. The actual soil consists of particles generally of high insulating strength, but in wet areas and seasons the solutions formed may become good conductors. The amount and type of salt to be used for lowering the ground resistance can easily be determined by a simple test (described). Ground beds may be either horizontal or vertical, the former consisting of two 6-ft.-deep trenches containing continuous lengths of pipe forming a V, at the junction of which a riser is welded. At the surface the copper cable from the generating unit is brazed to the riser. The vertical type consists of a number of vertical pipes, the tops of which are connected and buried with the tops at least 2 ft. below the ground line. The holes for the pipes are made by core-drilling machines, and after insertion of the pipe the hole both inside and outside the pipe is filled with drilling mud. The relative advantages and disadvantages of the two types of ground beds are summarized and indications given of the method of choice of location of ground beds and of reducing the resistance of the ground bed to the optimum limit of 1/10 ohm. C. L. G.

137. Electric Motors for Pipe-Lines. G. R. Prout. *World Petrol.*, 1937, **8** (5), 52.—Pipe-line operators are now thoroughly aware of the advantages afforded by the use of motor-driven centrifugal pumps with purchased power. Power companies and electrical manufacturers, as well as the pump-builders, appreciate the problems of pumping oil and gasoline in pipe-lines, and consequently are able to co-operate with pipe-line operators to a much greater extent in the solution of these problems. Where purchased power is not available, engine generators still permit the use of motor-driven centrifugal pumps, and provide many advantages which have proved out in actual operation over a period of time. With the foregoing in mind, it seems evident that the pipe-line industry should use electrical services and electrical equipment for pumping oil and gasoline to an even greater extent in the future. Types of motors used are discussed. W. W.

Gas.

138. Preparation of Pure Methane from Natural Gas. E. H. Boomer, C. A. Johnson and V. Thomas. *Canad. J. Res.*, 1937, **15** (9), 360.—A method for the removal of all hydrocarbons in natural gas other than methane is described. Pyrolysis of the light hydrocarbons under such conditions of temperature, pressure and rate of flow that methane remains unaffected is employed. The pyrolysis products are easily removed from the reaction mixture by ordinary chemical methods. H. E. T.

139. Patent on Gas. S. A. Kiss. U.S.P. 2,097,489, 2.11.37. Process of gasifying oils and coals. W. S. E. C.

Crude Petroleum.

140. Crude Oil from New Ordovician Field in West Texas Permian Basin. Anon. *Petrol. Engr.*, 1937, **9** (2), 56.—According to the laboratory analysis made by the U.S. Bureau of Mines on a sample obtained from a well, crude oil produced from Ordovician lime in the Sand Hills field in Western Crane Country, Texas, is a wax-bearing paraffin-intermediate base oil. Its properties are: sp. gr. 0·803, sulphur content 0·22%, viscosity S.U. at 77° F. 40 secs., at 100° F. 37 secs., carbon residue 1·3%, colour greenish-black. A distillation summary indicates that the crude will yield approximately 35% gasoline and naphtha, 20% kerosine distillate, 12% gas oil, 12% heavier distillates, 18% residuum of sp. gr. 0·936 and carbon residue content 6·8%. The well from which the sample was obtained for analysis was completed at a total depth of 6014 ft. in a dolomite formation. It is the first important well in the Sand Hills field, and produces by natural flow. R. A. E.

See also Abstract No. 95.

Cracking.

141. Patents on Cracking. Houdry Process Corpn., and T. B. Prickett. E.P. 475,125, 15.11.37. Naphtha reforming and refining without intervening cooling and separation of fixed gases on the one hand and hydrocarbons higher-boiling than desired on the other.

F. Schick and E. Emilius. U.S.P. 2,097,989, 2.11.37. Catalytic cracking of hydrocarbons using as catalyst, activated coke residues.

M. Pier and E. Donath. U.S.P. 2,100,353, 30.11.37. Cracking of heavy hydrocarbon oils, together with a small quantity of finely-divided sulphur-immune hydrogenating catalyst and added hydrogen. W. S. E. C.

Hydrogenation.

142. Composition of the Products Obtained by the Hydrogenation-Cracking of Low Temperature Tar. C. C. Hall and C. M. Cawley. *J. Soc. chem. Ind.*, 1937, 56, 303T–308T.—This paper is an account of an investigation to determine the proportions of unsaturated, aromatic, naphthenic and paraffinic hydrocarbons present in the spirit and oil from the hydrogenation-cracking of low-temperature tar, and further, to determine the difference in the composition of the motor spirit obtained by the use of two different catalysts.

The method of analysis adopted is based on the published data of Garner and of Griffith, and is essentially a modification of the latter's method for gas oil. The oil under examination has been cut into four fractions, up to 170° C., 170–200° C., 200–300° C. and residue above 300° C., and the analysis of each fraction is tabulated. The mean composition is: unsaturated 2% by weight, aromatics 57%, naphthenic 31%, paraffinic 10%. Although they consider that this method cannot be applied with accuracy to the saturated bodies without further study, the authors believe that a rough indication is obtained.

The paper continues with a very detailed analysis of a spirit fraction from a hydrogenated oil, in which the densities and aniline points of fractions of varying boiling ranges have been determined. This data, in conjunction with published data on pure hydrocarbons, has been the basis on which are tabulated the probable individual hydrocarbons present throughout the entire range.

Regarding the effect of catalysts, the above work was carried out on oils formed utilizing a molybdenum catalyst supported on alumina gel, but when pelleted molybdenum disulphide is used there occurs a great increase in the paraffinic content at the expense of the aromatic and naphthenic content. This fact is considered of great importance, as it demonstrates the probability that naphthenes are being cracked to paraffins. The spirits have the following characteristics, alumina supported catalyst: aromatic hydrocarbons 27%, naphthenic 66%, paraffinic 7%, octane no. 70. Pelleted catalyst: aromatic 2%, naphthenic 50%, paraffinic 48%, octane no. 70. The fact that the octane numbers are equal is considered to indicate that the paraffinic hydrocarbons contain a high proportion of the branched-chain type. T. C. G. T.

143. Hydrogenation-Cracking of Wax from Low-Temperature Tar. C. M. Cawley and C. C. Hall. *J. Soc. chem. Ind.*, 1937, **56**, 445T–446T.—The fact that during the hydrogenation cracking of low-temperature tars wax accumulated in the recycle stock, indicated that under the conditions of processing—namely, 1 to 5 minutes contact, molybdenum catalyst, 480° C., and 200 atms. of hydrogen—the wax was stable. Experiments by other workers showed that under such conditions the wax ought to decompose, but that time of contact may affect the results. The authors have carried out a series of experiments in which they have subjected paraffin and low-temperature tar waxes to 100 atmospheres of hydrogen and 450° C. for 2 hours, with and without molybdenum catalyst.

The conclusions to be reached from their investigation may be summarized :—

(1) Low-temperature tar waxes are unaffected when subjected to hydrogenation cracking at 480° C. in a continuous plant in the presence of a molybdenum catalyst with times of contact of 1 to 5 minutes.

(2) At longer times of contact low-temperature tar wax is completely unstable at lower temperatures. Thus at 450° C. it is completely decomposed after a time of contact of 2 hours to a water-clear spirit and a larger proportion of gaseous paraffin hydrocarbons.

(3) The liquid products are mainly paraffinic hydrocarbons containing a small proportion of other hydrocarbons which may be naphthenic.

(4) Paraffin wax behaves similarly to low-temperature tar wax. T. C. G. T.

144. Technology 1937. A. F. Enström. *Tekn. Tidskr.*, 27.11.36 (Allm. Avd. No. 48), 511–517.—In his yearly report regarding the progress in various branches of technology, Enström, member of the Royal Board of Trade and managing director of the Swedish Academy of Engineering Sciences, points out the general shift in interest from mechanical to chemical processes, and deplores the fact that Sweden lacks large chemical industries financially able to undertake plant-scale experimentation for development purposes. While the cellulose and pulp industries are usually classified as chemical, they are mainly of a mechanical and thermodynamical character, and are consequently more interested in developments in those fields than, for instance, synthetic production of petroleum hydrocarbons. A plant for such production has been erected at the Perstorp Works of the Skånska Ättiksyrefabriken, based on experimental work at the Academy (Abstracts Nos. 78, 89 and 493, 1937). This plant, the erection of which has been delayed because of difficulties in obtaining plant apparatus, will use wood as raw material, and will produce other products besides hydrocarbons. No information is given regarding the contemplated production, the exact nature of the raw materials and the capacity of the plant. Other methods of synthetic production of motor fuels have been considered. High-pressure hydrogenation of wood is not thought to be suitable, whilst shale oil, tar and rosin from sulphate liquors seem to offer promise as raw materials in hydrogenation plants. The Fisher–Tropsch process is also considered feasible, as it is possible, at least theoretically, to obtain the gas from wood rather than peat. This is connected with the problem of large-scale operation of generators utilizing wood as raw material, and practical experience in this field is lacking. The importance of alcohol will probably increase, and methods of its production from wood other than by fermentation of sulphite liquor are available. Charcoal gas operation of automobile engines has been perfected. R. F. S.

145. Patents on Hydrogenation. C. H. Verity. E.P. 475,033, 8.11.37. Improved electrically-heated retorts for low-temperature carbonization.

H. E. Potts. E.P. 475,911, 29.11.37. Production of *iso*-octane from di-*iso*butylene by passing the latter at 200–300° C. and under pressure, together with 1% by wt. of water vapour and excess free H_2 over a stationary catalyst containing molybdenum.

M. Pier, W. Simon and W. Kroenig. U.S.P. 2,098,400, 9.11.37. Destructive hydrogenation of middle oil or distillable carbonaceous substances at 440° C. and under 200 atm. pressure in the presence of a catalyst, *e.g.* tungsten sulphide and manganese bromide.

M. Pier, W. Simon and P. Jacob. U.S.P. 2,100,352, 30.11.37. Process as described above, the catalyst being a carrier containing activated carbon.

M. Pier, W. Simon and G. Grassl. U.S.P. 2,100,354, 30.11.37. Process as described above, the catalyst being Al, Mg and Al bronze and HCl. W. S. E. C.

Polymerization.

146. Polymerization in Relation to Natural Gasoline Manufacture. H. N. Wade. *Oil Gas J.*, 2.12.37, **36** (29), 35.—A description is given of the Unitary thermal polymerization and of the Dubbs catalytic process with flow-sheets, analyses of yields and details of operating cost, for the production of polymer gasoline from hydrocarbons produced by natural gasoline stabilizers. Both processes involve cracking the paraffin feed stock into unsaturateds, the thermal process polymerizing these during this operation, whilst in the catalytic process the fractionated products of cracking are further treated with a catalyst. In both processes the final products are fractionated to the required gasoline boiling range. Yields given by the Unitary thermal process from a mixture of 56·6% by weight of propane and 43·4% butane are 38·5% by weight of polymer gasoline (89·3% on the butane), and from a mixture of 61·5% of propane and 38·5% of butane, 38·5% of polymer gasoline.

Yields from a commercial Dubbs catalytic process operating or practically pure fractionated butane are given as 0·35 gallon of gasoline per gallon of raw butane (45% by weight on the butane). The conversion of propane by this process is considered too low to warrant the additional plant capacity required.

The analyses of a typical finished polymer gasoline is given as I.b.pt. 99° F., 69% dist. to 212° F. and e.pt. 405° F., gravity 62–65° A.P.I., vap. pressure (Reid) 9·2, O.N. 80/85 and blending value up to 110. Vapour-phase clay treatment yields a 30 + colour stable gasoline of satisfactory gum content—10 mgm./100 c.c. The gasoline is predominantly paraffinic in composition.

The cost of a Dubbs catalytic process to handle 1000 brls. per day of raw feed is estimated at about $300,000, exclusive of storage, steam and compressed-air facilities. The cost of a thermal polymer plant is probably about the same. A considerable investment, often equal to that of the actual polymerization unit, may be required to increase the extraction of butane or butane propane from the stabilizer plant.

Operating costs (analyses given) of two thermal plants producing 2100 brls. and 1000 brls. per day are estimated at 5·51 cents and 6·48 cents per gallon, the intake material being assessed at 1 cent per gallon, assuming that there is no other offtake for it. It is emphasized that in very few cases could a polymer plant compete economically with other methods of producing fuel, but the expense may be justified where the blending value of the gasoline is greater than the value as straight motor fuel.

For this reason a Dubbs catalytic process plant showed a satisfactory profit in a locality at which the price of finished gasoline at the refinery was about 4½ cents per gallon. C. L. G.

147. Patents on Polymerization. A. Carpmael. E.P. 474,831, 4.11.37. Polymerization of olefines using as catalyst acids of phosphorus, acid esters of acids of phosphorus and compounds of boron trifluoride.

F. B. Dehn. E.P. 475,552, 18.11.37. Polymerization products by polymerizing substances containing the group $CH_2 = C<$ which are liquid at room temperatures, and subjecting the mixture to the action of a centrifugal force to form solid or semi-solid products.

H. Rabe and M. Otto. U.S.P. 2,097,468, 2.11.37. Production of lubricating oil by polymerizing a normally liquid product containing *iso*-olefines resulting from the cracking of a paraffin wax at below 10° below zero and in the presence of a volatizable inorganic halide of the Friedel–Crafts type.

M. de Simo and F. B. Hilmer. U.S.P. 2,099,513, 16.11.37. Production of lubricating oils from crude polymers which are separated by means of selective solvents.

R. F. Ruthruff. U.S.P. 2,099,755, 23.11.37. Polymerization of gaseous olefins to produce motor spirit and lubricating oil. W. S. E. C.

See also Abstracts Nos. 215 and 227.

Refining and Refinery Plant.

148. Principles of Solvent Dewaxing. Part II. M. B. Thi, T. G. Hunter and A. W. Nash. *J. Instn. Petrol. Tech.*, 1937, **23**, 707–722.—This paper is an attempt to represent equilibria and devise computations for solvent systems employing a double solvent completely miscible with the oil at the operating temperature. G. R. N.

149. Dewaxing with Heavy Solvents. B. Engel. *J. Instn. Petrol. Tech.*, 1937, **23**, 723–733.—It is shown that, by using a suitably specific heavy solvent or combination of solvents, distillates and residues originating from different crudes can be successfully dewaxed by means of centrifuges, and in some cases when treating oils rich in asphalts and resins a partial precipitation and removal of these are possible, simultaneously with dewaxing. G. R. N.

150. Influence of Certain Substances on the Separation of Paraffin Wax from Oil in a Dewaxing Process. E. C. H. Kolvoort, F. R. Moser and C. G. Verver. *J. Instn. Petrol. Tech.*, 1937, **23**, 734–745.—The higher-boiling fractions of waxy crude oils frequently contain paraffin wax of poor crystalline character which does not filter easily, and which has a high oil retention. The authors believe that this can be explained by the occurrence of branched-chain paraffins in addition to the normal type. The use and action of "pour point depressants" to overcome these disadvantages are discussed from the practical and theoretical standpoints. G. R. N.

151. Methyl Normal-Butyl Ketone as a Dewaxing Solvent. O. S. Pokorny and R. K. Stratford. *J. Instn. Petrol. Tech.*, 1937, **23**, 746–750.—After enunciating the desirable characteristics of a dewaxing solvent, the authors describe shortly experiments with methyl-*n*-butyl ketone, which indicate it is suitable for the purpose. G. R. N.

152. Howard Process Applied to Treatment of Refinery Gasoline. E. Kaye. *Oil Gas J.*, 28.10.37, **36** (24), 50; *Petrol. Engr.*, Nov. 1937, **9** (2), 45; *Refiner*, 1937, **16** (12), 580.—A flow chart of the treating unit shows that stabilized gasoline (with propane, H_2S and excess butane eliminated by fractionation) to which chlorine has been added is vaporized in a fractionating column and the vapours are passed into a contact tower below a bed of oxidized zinc, *e.g.* zinc oxide or oxychloride, which is dispersed through the tower in a solid binder of one of various possible kinds. The vapours issuing from the tower are then fractionated and the overhead is condensed as finished gasoline. Polymers from the final fractionator and from the bottom of the contact tower are fed to the stripper tower with the raw gasoline, and ultimately the bottoms from this tower containing all the stripped polymers are diverted to fuel oil or other operations, according to plant practice.

Gasoline—straight-run or cracked—treated by the process is of excellent odour, good colour and colour stability even on exposure to light, and low gum content. High induction periods ranging from 6 to 10 hrs. for vapour phase and 15 to 30 hrs. for Mid-Continent cracked gasoline from conventional cracking plants are quoted. The sulphur reduction is material, amounting to as much as, or more than, the mercaptan sulphur content of the charge. The octane rating of the treated gasoline is the same as that of the charge, there being no diminution in octane rating, as is the case with conventional acid and plumbite processes. The lead susceptibility of the treated gasoline is substantially better than that of the untreated, especially where mercaptan content of the untreated product is high.

For naphthas requiring approximately 3 mls. of lead for 70 octane number before treatment, the lead required was reduced to 1 ml.

Pilot plant operation points to a long life for the oxidized zinc, and it has been found that the chemical may be regenerated by turning steam into the bed. Some erosion of the bed has occurred, but changes in flow which should eliminate this condition have been made. A commercial plant just placed in operation will show whether these changes are effective, and the life of the chemical bed will determine the ultimate cost of the process.

Properties of pressure distillate and straight-run gasoline produced from Kansas crude before and after treatment by the process are tabulated. R. A. E.

153. Trends in Natural Gasoline Plant Design. W. L. Rifenberick. *Petrol. World* (LA), 1937, **34** (6), 71.—Reviews early installations and the progress in design during the past fifteen years. In recent practice the main idea is to do away with uncondensed vapours in the plant, without recycling, get rid of them once and for all, either by putting them directly into the rectifier, or eliminate them with a fat oil rectifier.

The crude oil rectifier is coming into its own, in that it eliminates the large cost of lines and vapour-recovery systems on storage tanks.

Another very decided trend in the industry is towards centralized rectification of the finished gasolines. More and more of the companies are doing away with their field rectifiers and piping the casing-head to the refineries, where it is being fractionated into casing-head, bottle gas and fuel.

Metering of the gasoline by positive displacement meters with thermostatic correction is also being looked upon with favour, since it is generally more accurate than tank gauging. W. W.

154. Effect of Acid Refining upon Ozokerites. K. S. Nitsche. *Ole, Fette, Wachse*, 1937, (6), 1.—The well-known homogenizing effect of ozokerite in paraffin wax-solvent pastes is markedly lessened by decolorizing with sulphuric acid. Earth treatment does not have this effect, and should be used unless extreme bleaching is necessary. The acid appears to destroy constituents of the ozokerite which are particularly active in causing homogeneity. P. G. H.

155. Improved Packed Fractionating Columns. D. F. Stedman. *Canad. J. Res.*, 1937, **15** (9), 383.—The utility of various packings for fractionating columns and the factors on which this utility depends are considered in some detail. By a careful consideration of these factors a type of packing is developed and described which gives an effectiveness up to twenty plates per foot of height, and has a capacity at least equal to similar equipment of lower efficiency. These packings are constructed of fine-mesh wire gauge, and moreover special constructions are described for laboratory use and also for high-capacity apparatus. The method of calibration is given and factors are evaluated for comparison of various packings for both batch and continuous stills. H. E. T.

156. Progress of Manchester Oil Refinery, Ltd.'s, Plant. Anon. *Petrol. Times*, 11.12.37, **38** (987), 755.—This plant, which is approaching completion, is identical with the "Aquila" plant at Trieste. It comprises a vacuum distillation unit, acid and clay-treating plants and a solvent-extraction refinery plant, the latter operating on sulphur dioxide/benzol. Pilot work has indicated that the lubricants produced will have low carbon values and outstandingly good gravity and viscosity indexes, together with good flash-point, cold test and demulsibility characteristics. It is anticipated that a transformer oil to comply with the B.S.I. specification will be produced with much lower gravity and viscosity than are usually associated with transformer oils. A small quantity of gas oil of cetane value 70 will be produced. The total capacity of the plant will be 100,000 tons per annum. H. G.

157. Talco Refinery Designed Primarily for Producing Asphalt. A. E. Burges. *Petrol. Engr.*, Dec. 1937, **9** (3), 53.—A description is given of a refinery at Mt. Pleasant, Texas, designed to handle 7000 brls. Talco (East Texas) asphalt base crude oil. The plant consists of a combination atmospheric and vacuum unit producing gasoline, naphtha, kerosine, gas-oil and asphalt, a cracking unit operating on gas-oil or reduced crude from the atmospheric unit and a reforming unit operating on the naphtha or straight-run gasoline. In the distillation unit the furnace used is a double-coil type in which the convection section, hip tubes and one radiant section are used for the crude and the other radiant section for the asphalt. Twin 3-stage steam ejectors are used to maintain a pressure of 0·5 in mercury. Owing to the corrosive nature of the crude lime, slurry is injected into the cracked fractionating column, whilst the piping, furnace tubes, valve fittings and pumping equipment are constructed of 4–6% Cr 0·5 Mo steel. The refinery is expected to produce 2500 brl. of 68–70 octane gasoline daily, in addition to penetration asphalts and cutbacks and blown asphalts. The plant is reported to have cost $1,500,000. C. L. G.

158. Close Fractionation Obtained in Texas Company Crude Unit. G. Weber. *Oil Gas J.*, 23.12.37, **36** (32), 53.—A new distillation unit at Port Arthur, Texas, processes 18,000 brls. per day of North Texas crude in two stages, producing gasoline, solvent naphtha, kerosine and light gas-oil in the atmospheric stage and gas-oil, four side

streams of lubricating oil distillate and heavy fuel oil residue in the vacuum stage which operates at 12 mm. Hg. absolute pressure. The crude yields 30% of gasoline of 330 e.pt., 2% of 330–390° F. naphtha, 15% of 365–485° F. kerosine, 2% of gas-oil of 495° F. I.b.pt., 26% of four lubricating distillates ranging from viscosity 80 S.U. at 100° F. to 175 S.U. at 210° F. and 7% of fuel oil. C. L. G.

159. Corrosion Testing of Metals and Alloys Used in Refineries. D. R. Crampton and N. W. Mitchell. *Oil Gas J.*, 9.12.37, **36** (30), 69.—For laboratory corrosion tests on metals, particularly copper alloys, the tensile strength of the corroded specimens gives a better indication of practical serviceability than measurement of loss of weight. Brasses undergo selective solution without appreciable loss of weight, but with severe damage to their serviceability. Intercrystalline corrosion has the same result. On the other hand, considerable losses in weight may take place with general thinning which causes only a small drop in tensile strength. Removal of the products of corrosion for weighing purposes is slow, difficult and frequently impossible without removing some of the metal. No cleaning, however, is necessary for tensile strength determinations, whilst it automatically shows the area where greatest damage by corrosion has taken place.

Where possible strips are exposed in the actual equipment, *i.e.* condenser or heat exchanger, etc., where corrosion difficulties are experienced. C. L. G.

160. Formation of Calcium Sulphate Hemi-Hydrate Scale. E. C. B. Bott. *J. Soc. chem. Ind.*, 1937, **56**, 453T–456T.—An investigation by the author into the above problem is described and a diagram illustrates the apparatus used. Quantitative measurements on calcium sulphate hemi-hydrate scale formation from brine containing suspended and/or dissolved calcium sulphate show that the scale is formed by a crystallation process. Other conclusions to be reached from the experiments are :—

(1) That the rate of scale formation under constant conditions decreases exponentially with time and is proportional to the temperature of the heating surface. It is unaffected by changes in the velocity of the liquor or by the roughness of the heating surface.

(2) That the addition of sodium sulphate to a brine containing calcium sulphate will cause glauberite to be precipitated as a sludge, and not as a scale. T. C. G. T.

161. Deposition of Scale Below Boiling Point. E. G. Barber. *Fuel Econ.*, 1937, **13** (146), 498–502.—Calcium carbonate commences to be deposited from solutions of the bicarbonate at temperatures above 80° F., and is the main constituent of scale formed in water which does not reach boiling point, *e.g.* condensers and economizers. An analysis of a scale typical of those under discussion is given, which shows 77·6% calcium carbonate.

A general outline of its occurrence, prevention and removal follows. In dealing with prevention, sulphuric acid and caustic-soda methods are suggested, it being assumed that systematic and complete softening is impracticable. Chlorination is recommended for prevention of organic growths, a typical plant for this purpose being illustrated, and control tests indicated.

Removal of the scale is effected by the use of hydrochloric acid, tannin being added as an inhibitor to retard the corrosion of ferrous alloys.

All suggested methods are supported by practical hints and precautions to be observed during their operation. Photographs illustrate the effect of the treatment. T. C. G. T.

162. Patent on Plant. H. R. Austin. U.S.P. 2,100,895, 30.11.37. Corrosion-resistant lining for vessels. W. S. E. C.

Fire Prevention.

163. Cause, Prevention and Control of Petroleum Fires. J. T. Howell. *Petrol. Engr.*, Dec. 1937, **9** (3), 40; and *Oil Gas J.*, 23.12.37, **36** (32), 33.—An outline is presented of the elementary principles underlying the causes of petroleum fires, these being illustrated by simple demonstrations. Prevention and control of fires are dealt with from a theoretical basis. C. L. G.

Chemistry and Physics of Petroleum.

164. Oxidation of Propane. Part I. Products of the Slow Oxidation at Atmospheric and at Reduced Pressures. D. M. Newitt and L. S. Thornes. *J. Chem. Soc.*, Oct. 1937, 1656–1665.—The authors have adopted a static method of experimentation in which a previously mixed propane–oxygen mixture is rapidly admitted to a reaction vessel maintained at any desired temperature. Progress of the reaction is followed by manometric observations, and by analysis of samples withdrawn at various stages of the reaction.

The first part of the paper describes the influence of pressure on the inflammation limits of an equimolecular propane–oxygen mixture. The variations with pressure of the S.I.T. of such a mixture reacting in a silica vessel have been determined. Below 370 mm. there is only one temperature limit of inflammability which decreases with increase of pressure. Between 370 and 535 mm. there are three, and above 535 mm. there is again only one limit which changes very little with further increase in pressure. At atmospheric pressure the mixture will always ignite at about 270° C.

The region in which cool flames exist has been studied, and is indicated in a graph. It is concluded that a necessary condition for cool-flame inflammation is a critical high concentration of higher aldehydes. During the passage of the flame the aldehydes are further oxidized to give aldehyde peroxides and/or peracids, and ultimately formaldehyde.

The distribution of oxygen in the products has been determined by analysis, and the methods employed are described. W. E. J. B.

165. Oxidation of Propane. Part 2. Products of the Slow Oxidation at High Pressures. D. M. Newitt and W. G. Schmidt, *J. Chem. Soc.*, Oct. 1937, 1665–1669.—It is shown that when propane is oxidized at high pressures, *iso*propyl alcohol and acetone are found in the products in circumstances, suggesting that they arise from direct oxidation of the hydrocarbon molecule at the β-carbon atom.

n-Propyl, ethyl, and methyl alcohols are also formed in considerable quantities, the yield of the higher alcohols being favoured by increase of pressure.

The results suggest that propane undergoes oxidation in two ways, the initial products in the one case being *n*-propyl alcohol and propaldehyde, and in the other *iso*propyl alcohol and acetone. W. E. J. B.

166. Oxidation of Propane. Part 3. Kinetics of the Oxidation. D. M. Newitt and L. S. Thornes. *J. Chem. Soc.*, Oct. 1937, 1669–1676.—The conditions under which the reaction of an equi-molecular propane–oxygen medium has a negative temperature coefficient have been investigated, and the coefficients for the surface and homogeneous reactions measured separately.

The influence of vessel diameter and of diluents on the rate of reaction is shown to be such as would result from the operation of a chain mechanism. The analytical and kinetic results as a whole suggest that the intermediate stages exerting a controlling influence on the course and rate of the combustion are: (1) an initiating process which almost certainly starts as a surface reaction and gives rise to concentrations of a higher aldehyde, (2) a series of homogeneous reactions by which the higher aldehyde is reduced stepwise to formaldehyde, and (3) a reaction occurring simultaneously with (2) and resulting in the aldehyde (or some intermediate product of its further oxidation) undergoing thermal decomposition. W. E. J. B.

167. Ultra-Violet Absorption Spectra of the Isomers of Butene-2 and Pentene-2. E. P. Carr and H. Stückeen. *J. Amer. Chem. Soc.*, 1937, **59**, 2138–2141.—The ultra-violet absorption spectra of *cis*- and *trans*-butene-2, *cyclo*hexene and different samples of pentene-2 have been examined in vapour phase in the Schumann region. The marked similarity between the spectra of the higher-boiling butene-2 and *cyclo*hexene confirms the earlier assignment of the *cis*-configuration to the isomer.

The absorption curves for two samples of pentene-2, which from their methods of preparation should give two different geometrical isomers, showed intensity relation-

ships which were entirely analogous to those shown by the *cis*- and *trans*-isomers of butene-2. The differences were sufficiently marked to serve as a basis for identification of the two isomers; the higher-boiling pentene-2 is the *cis*-form.

The comparative yields of the two isomers of pentene-2 prepared by four other methods have been estimated from their absorption spectra. W. E. J. B.

168. Rearrangement of Acetylenes into Allenes at High Temperatures. C. D. Hurd and R. E. Christ. *J. Amer. Chem. Soc.*, 1937, **59**, 2161–2165.—1-Hexyne and 1-heptyne were pyrolysed at temperatures of 500°, 550° and 600° C. The chief gaseous products were propylene, methane and ethylene, but some ethane and hydrogen were also formed.

By ozonolysis it was established that the liquid products from 1-hexyne contained 1 : 2-hexadiene, and that the liquids from 1-heptyne contained 1 : 2-heptadiene. Except in the experiment at 600° C., there was no evidence for the production of 2-alkynes, and then only in traces. Aromatic hydrocarbons or 1 : 3-alkadienes were not formed. Similarly, in work with 1-butyne at 560° C., the absence of 1 : 3-butadiene was established. The rearrangement of 1-alkynes into 1 : 2-alkadienes does not proceed at 400° C., but requires temperatures which are high enough to cause concurrent breakdown into gaseous products.

A suggested reaction mechanism to account for the above facts is given.

W. E. J. B.

169. Hydroxylation of Unsaturated Substances. III. Vanadium Pentoxide and Chromium Trioxide as Catalysts of Hydroxylation. N. A. Milas. *J. Amer. Chem. Soc.*, 1937, **59**, 2342–2344.—The behaviour of the oxides of vanadium and chromium as catalysts for the hydroxylation of various organic compounds, including trimethylethylene and benzene, is described. The former yields trimethylethylene glycol, and the latter phenol. Similarly, cresols are obtained from toluene and naphthols from naphthalene.

In general the reaction is effected by dissolving the catalyst in a mixture of either anhydrous tertiary butyl, or anhydrous amyl alcohol, and hydrogen peroxide. To this is added the hydrocarbon, when the reaction proceeds without the application of heat. The reaction appears to proceed through the intermediate formation of the unstable peracids of the catalysts used, *e.g.* pervanadic and perchromic acids.

IV. Catalytic Hydroxylation of Unsaturated Hydrocarbons. N. A. Milas and S. Sussman. *J. Amer. Chem. Soc.*, 1937, **59**, 2345–2347.—This paper describes the hydroxylation of several unsaturated hydrocarbons by hydrogen peroxide dissolved in anhydrous tertiary butyl alcohol with osmium tetroxide as catalyst.

The apparatus used is described, and, amongst others, the following glycols have been prepared: ethylene glycol in 97% yield from ethylene, propylene glycol in 68% yield from propylene and pentanediol 2–3 in 30% yield from pentene-2.

W. E. J. B.

170. *cis*- and *trans*-Isomers of Pentene-2. M. L. Sherrill and E. S. Matlack. *J. Amer. Chem. Soc.*, 1937, **59**, 2134–2138.—The authors have prepared each of the geometrical isomers of pentene-2 by a method which should give only one isomer.

The *trans*-form has been prepared from α-ethyl-β-iodobutyric acid, whilst the *cis*-form has been prepared from α-ethylcrotonic acid and pentyne-2.

The b.pt. of the *trans*-form at 760 mm. is 36·25° C., d_4^{20} 0·6486 and n_D^{20} 1·3790. The *cis*-form from the acid gave b.pt. at 760 mm. 36·55° C., d_4^{20} 0·6540 and n_D^{20} 1·3817, whilst the *cis*-form from pentyne-2 gave b.pt. at 760 mm. 37·8° C., d_4^{20} 0·6586 and n_D^{20} 1·3822.

It is considered that this latter preparation represents the purer form of the *cis*-variety. The structure assigned, based on the method of synthesis, is in accordance with the structure determined from absorption spectra measurements.

Pentene-2 has been prepared from 3-bromo-2-ethyoxypentane and 2-bromo-3-ethyoxypentane and 3-pentanol, and the approximate proportions of the two isomers in each preparation have been determined. W. E. J. B.

171. Liquid Phase Reactions at High Pressures. Part II. Polymerization of Olefins. R. H. Sapiro, R. P. Linstead and D. M. Newitt. *J. Chem. Soc.*, Nov. 1937, 1784–1790.—The polymerization of the following substances at temperatures of 100–160° C. and pressures up to 10,000 atms. are described: α-methylstyrene, αβ-dimethylstyrene, α-*iso*propenylnaphthalene, *as*-diphenylethylene, ethyl cinnamate, *iso*amylene and Δ^{γ}-butenylbenzene.

The work in the main has concerned α-methylstyrene, and its polymerization is induced by pressures of 2000 atm. upwards, at temperatures of about 100° C., without the aid of added catalysts. The polymer obtained is a glassy material containing about 50 molecular units.

Such catalysts as were examined—*e.g.* dry hydrogen chloride, benzoyl peroxide and anhydrous zinc chloride—do not accelerate the reaction or lead to the production of polymers of higher molecular weight than those produced without a catalyst under the same conditions of temperature and pressure. Zinc chloride prevented the production of any higher polymer. An increase in the pressure at a given temperature gave a considerable increase in the yield of higher polymers. The effect of increased temperatures from 100 to 150° C. was to reduce the molecular weight of the high polymers. The mean molecular weight of the highest polymer obtained—*i.e.* about 5000–6000—indicated that it was still a hemicolloid, but the material possessed in some respects the properties of the more complex eucolloid type.

High polymerization among the substances studied is realized only in compounds of the type Aryl·CR:CH_2. W. E. J. B.

172. Treating Saturated Hydrocarbons to Produce Aliphatic Compounds. J. J. Pelc. *Oil Gas J.*, 9.12.37, **36** (30), 50.—Saturated as well as unsaturated hydrocarbons can react in the presence of catalysts (*e.g.* sulphuric acid) with aliphatic aldehydes, other than formaldehydes, and with aliphatic ketones forming additive compounds, which by further treatment and decomposition (hydrolysis and/or neutralization with an alkali) will yield olefines or alcohols derived from the saturated hydrocarbons (U.S. Pat. 2,011,199). Pure individual alcohols and olefins are given by starting with pure hydrocarbons, but by treating ordinary petroleum distillates partial alcoholization results, yielding a suitable fuel of improved characteristics with no tendency to develop gum or colour in storage. C. L. G.

173. Formation of Organo-Metallic Alkyl Derivatives of Aluminium during the Polymerization of Ethylene. F. C. Hall and A. W. Nash. *J. Instn. Petrol. Tech.*, 1937, **23**, 679–687.—Experiments are described for the isolation of a liquid organo-metallic compound of aluminium produced by the reaction between ethylene and aluminium chloride in the presence of aluminium. The properties of the compound and its influence on the polymerization of ethylene were investigated. G. R. N.

174. Oxidation of Methane at High Pressures. 1. Preliminary Experiments. E. H. Boomer and J. W. Broughton. *Canad. J. Res.*, 1937, **15** (9), 375.—This paper presents some preliminary results obtained by the catalytic oxidation of methane, with the primary object of obtaining high yields of methanol and with large conversion per pass of reactants. Viking natural gas, having the composition methane 95·7, ethane 1·4, propane 0·9, nitrogen 2·0%, was used in all the experiments. By using a steel reaction vessel, and various oxide catalysts at temperatures ranging from 235° to 450° C. and pressures of approximately 200 atms. either with natural gas alone or with a mixture of natural gas and oxygen (7·3% by vol. of oxygen), no appreciable yields of useful products were obtained in any case. Barium peroxide, vanadium pentoxide and blue tungsten oxide were relatively inactive, whereas two Hopcalite catalysts promoted oxidation violently for a short time and then became inactive. With an empty steel reactor oxidation proceeded rapidly to completion, the products being oxides of carbon and water, whilst the steel surface was severely corroded. The lowest temperature at which oxidation became apparent varied with the catalysts, *e.g.* for the Hopcalite catalysts 125° C.; copper and steel at 250° C., and silver at 200° C.

Metallic copper and silver deposited on asbestos were found to be superior to all other catalysts tried in the promotion of desirable reactions to give methanol. In

latter work the steel reactor was replaced by a tubular copper-lined vessel, and a series of experiments was performed using metallic copper and silver as catalysts with oxygen–natural gas mixtures, containing 7·3–7·5% of oxygen. The reaction products were analysed by a technique developed by the authors.

Methanol production was shown to be an important product of the catalytic oxidation of methane, other products being formaldehyde and formic acid. Yields of these three products as high as 37% of the carbon oxidized were obtained. H. E. T.

175. Oxidation of Methane at High Pressures. Part II. E. H. Boomer and V. Thomas. *Canad. J. Res.*, 1937, **15** (10), 401.—A systematic investigation of the direct catalytic oxidation of methane (natural gas from Viking field) using metallic copper as catalyst has been carried out. The variables studied were: composition of gas mixture, pressure, temperature and space velocity. Pure electrolytic copper in pieces $\frac{3}{16}$ in. square and $\frac{3}{32}$ in. thick were used as catalyst, and was activated by alternate oxidation and reduction prior to use, air being used as oxidizing agent and a mixture of hydrogen and methanol vapour as reducing agent. The copper was sensitive to sulphur poisoning, and precautions were taken to remove sulphur compounds from the gases. Mixtures of methane and air containing from 3 to 13% of oxygen as air were used; the temperature range was 350–500° C., and the pressure 140–230 atms.

Methanol was the principal reaction product, and yields as high as 74% calculated on the carbon oxidized were obtained. From the various results obtained it is concluded that the yield of methanol depends primarily on the catalyst, the oxygen concentration and the temperature; time of reaction and pressure within the experimental limits studied were relatively unimportant. Metallic copper as a catalyst fulfils two useful functions, in that it is relatively easily oxidized and reduced and aids in the dissipation of the heat of the exothermic reaction. H. E. T.

176. Oxidation of Methane at High Pressures. Part III. E. H. Boomer and V. Thomas. *Canad. J. Res.*, 1937, **15** (10), 414.—The investigation of the catalytic oxidation of methane has been carried a stage further, only "pure" methane mixed with nitrogen being used. The gas used analysed methane 94·3, nitrogen 5·7%. The catalysts used were copper, silver, nickel-chromium, steel and glass. The variables studied were composition of gas mixture, pressure and temperature. The inlet gas contained from 3 to 7% of oxygen, and pressures of 140–220 atms., at a temperature of 475° C. A discussion is appended in which the authors present a new mechanism for the various reactions which occur during the oxidation of methane. H. E. T.

177. Photochemical Researches on Mineral Oils. M. E. Vellinger. *Ann. Off. Combust. liq.*, 1937, **12**, 195–281.—The paper constitutes studies of the action of light on oils. Rates of oxidation have been measured, products of oxidation examined, and an attempt has been made to utilize the results of the researches to evaluate oils by a photochemical method. The work has entailed the study of the nature of petroleum hydrocarbons and the occurrence of materials other than hydrocarbons. The latter include nitrogenous bodies which the author considers to have had insufficient recognition. The metallic materials such as iron, nickel and vanadium are also considered. The article opens with a very complete survey of the literature regarding this very extensive subject.

In the experimental work the oils examined have been degasified before exposure to light. The oils are allowed to absorb oxygen, the quantity of which is accurately measured. Details of the lighting equipment, degasifier and oxygen absorption meter are given. Oxygen absorption has been measured at different pressures and light intensities. The effect of various factors, such as temperature of test, origin of oil and acid and earth treatments of oil, has been investigated, as has also the effect of catalysts. The characteristics of the oxidized oils are discussed and the products of oxidation receive attention. Measurements of interfacial tension between the oils and aqueous solutions form the basis of much experiment, and have been shown to be a method of determining the degree of refinement or of light oxidation deterioration.

In conjunction with the above a great deal of work has been carried out on the

absorption spectrum of hydrocarbons and oils, and the relation between absorption of light and of oxygen is discussed.

In conclusion, it is found that the speed of light oxidation is proportional (1) to the intensity of the light, (2) to the quantity of light absorbed by the oil.

For Venezuelan, Texas, Pennsylvanian and Colombian oils the effect of origin on rate of light oxidation is negligible in comparison with the effect of factors such as refining, etc. The well-refined oils show greatest stability, although they can be over-refined. Preventives of heat oxidation show little effect on light oxidation. The quantity and activity of bodies formed during light oxidation depend on the origin of the oil, Venezuelan being the worst. T. C. G. T.

178. Mechanical Stimulation of Oil Orientation. M. Aubert and A. Pignot. *Ann. Off. Combust. liq.*, 1937, **12** (2), 283–294.—The phenomenon of double refraction has, it is claimed, been observed in films of mineral oils subjected to mechanical stress. The films are of such dimensions that laminar effects are considered excluded. It is also considered that the condition of dissymmetry is the result of orientation of the molecules. In the experiments, light from an arc lamp is filtered and polarized before passing through the oil film. After subsequent passage through a compensator and a Nicol prism, it can be received either on a screen or on a photographic plate. The apparatus for subjecting the oil film to mechanical stress consists briefly of an inner cylinder rotating inside a fixed outer cylinder, the space between being filled with air-free oil. The apparatus is fully described and illustrated by sketches. It is pointed out that reproduction of the phenomenon is uncertain. Some aspects of the phenomenon are dealt with, but discussion of the results is deferred until the publication of a further article. J. L. T.

179. Studies in the Mechanism of Flame Movement. Part IV. The Vibratory Period. H. F. Coward, F. J. Hartwell and E. M. Georgeson. *J. Chem. Soc.*, Sept. 1937, 1482–1489.—The authors have investigated the vibratory movement during propagation of flame in various mixtures of methane and air, but mainly a mixture containing 10% of methane.

The explosive mixture was contained in tubes of various dimensions and the flame travelled from an open towards a closed end. Each of the frequencies observed in tubes up to 10 metres in length corresponded with the fundamental note or with a low overtone of the whole column of gas in the tube, as calculated from Lees's formula. In a tube 32·3 metres in length vibrations were less regular, but many of them corresponded with the fundamental note.

Various means were discovered for suppressing the vibrations of such a flame, including a partial closure of the open end of the tube and a provision of gauze releases along the wall of the tube. In a certain tube of square cross-section the flame failed to vibrate, whereas in a tube of equal length and equal (but circular) cross-sectional area the vibrations were large in amplitude. W. E. J. B.

Analysis and Testing.

180. Suggested Method for the Sampling of Petroleum Products. E. Norlin. *Tekn. Tidskr.*, 9.10.37 (Kemi No. 10), 79–81.—Detailed description of the procedure to be followed when sampling liquid, semi-liquid and solid petroleum products, to be issued as Swedish Standard. Separate methods are given for sampling tanker cargoes, large tanks, railway tank waggons, barrels and smaller packages. A special form is suggested when the samples are to be legally acceptable. R. F. S.

181. Suggested Standard Method for Determination of Saponification Number. Anon. *Tekn. Tidskr.*, 2.1.38 (Kemi No. 1), 7–8.—Detailed description of the procedure for determination of saponification number, to be issued as Swedish Standard. It is stated that apart from being a characteristic of fatty oils, saponification number can also serve as an indication of the degree of oxidation which a used mineral oil has undergone in service. Errors are 0·2 for values below 10, 1 for values between 10 and 40, and 3 above 40. The main difference between the proposed method and the A.S.T.M. D. 94–36 is the time of boiling, which is fixed at 2 hours for saponification numbers above 10, using a 10-gm. sample. For saponification numbers below 10 a 30-gm. sample is employed with a boiling time of 3 hours. R. F. S.

182. Suggested Method for Determination of Neutralization Number. Anon. *Tekn. Tidskr.*, 11.12.37 (Kemi No. 12), 108.—Detailed description of the procedure for determination of neutralization number, to be issued as Swedish Standard. The proposed method differs from the A.S.T.M. D. 188–27T in several respects. Neutralization number is defined only as the no. of mg. KOH required to neutralize 1 gm. of oil. 10 gm. of oil are dissolved in 40-c.c. indicator solution (1·2 gm. of Alkali Blue 6 B in 1000 c.c. pure C_6H_6 and 1500 c.c. 96% or more EtOH) and titrated rapidly with 0·1*N*-alcoholic KOH solution. A method for determination of water-soluble acids is also given. Both methods are stated to be accurate within 0·1 neutralization number.
R. F. S.

183. Suggested Standard Method for Determination of Steam Emulsion Number. Anon. *Tekn. Tidskr.*, 11.12.37 (Kemi No. 12), 107–108.—Detailed description of the procedure for determination of steam emulsion number, to be issued as Swedish Standard. The proposed method follows the A.S.T.M. D. 157–36 closely, the most important difference being that results shall be expressed in minutes instead of in seconds.
R. F. S.

184. Determination of Small Proportions of Sulphur. V. Zahn. *Industr. Engng. Chem. Anal.*, 1937, **9** (11), 543.—When a volatile organic substance containing less than 0·01% sulphur is analysed by the lamp method (A.S.T.M. Method No. D. 90–34T) for this element, the impurities in the air used for combustion and the formation of small amounts of acids in the flame constitute sources of major error. To overcome these and to increase the accuracy of the method to determine proportions of sulphur as low as 0·001%, details are given with regard to purifying the air for combustion and for estimating the sulphur as barium sulphate turbidimetrically. Sodium hypobromite is used to absorb the products of combustion.
G. R. N.

185. Modification of the A.S.T.M. Lamp Sulphur Method for Refined Kerosines. E. Field and F. H. Dempster. *Industr. Engng. Chem. Anal.*, 1937, **9** (11), 547.—The lamp method, A.S.T.M. No. D. 90–34T, has been modified to obtain a considerably greater degree of accuracy on refined kerosines, *i.e.* with sulphur contents of the order of 0·010%. It may be used also on other refined oils covered by this method. Data are given to show that it is essential to use purified air during burning. A greater amount of sample must be burned, hydrogen peroxide is to be preferred as an absorbing medium, and if accurate, reliable results are to be obtained, the total sulphur after absorption must be determined by gravimetric means.
G. R. N.

186. Microdetermination of Organic Sulphur. W. Saschek. *Industr. Engng. Chem. Anal.*, 1937, **9** (10), 491.—After combustion of the sulphur-containing compound by Pregl's micro-method the contents of the tube are washed into a thin-walled porcelain crucible (preferably with black interior glazing) of about 15 ml. capacity. The gravimetric determination of the sulphur as barium sulphate is carried out, using this crucible and a porcelain filter stick only. The technique of this method is described, and it is claimed that it avoids the difficulties of all other methods so far proposed. Twelve references.
G. R. N.

187. Determination of Butenes in Refinery Gases. W. A. McMillan. *Industr. Engng. Chem. Anal.*, 1937, **9** (11), 511.—A new method is presented for the determination of the individual hydrocarbons of the C_4 group which normally occur in refinery and cracked gases. By its use they can be determined within an accuracy of better than ± 0·15%, with the exception of the isomeric 2-butenes. The method consists of the separation of two cuts by exact low-temperature distillation in the author's apparatus. The first cut, containing *iso*butane, *iso*butene and 1-butene, is subsequently hydrogenated over a nickel catalyst to obtain the total unsaturation of the cut, and the *iso*butene is then determined separately by reaction with anhydrous hydrogen chloride. The second cut, containing all of the *n*-butane and 2-butenes, is also hydrogenated for total unsaturation, and the residual gas is condensed into a bulb and treated with bromine at low temperatures. The dibromides are subsequently left as a residue on warming the mixture, and are determined by measurement of the refractive indices. Thirteen references.
G. R. N.

188. Photometric Determination of Added Phosphorus in Oils. P. Goodloe. *Industr. Engng. Chem. Anal.*, 1937, **9** (11), 527.—One gm. of the sample is mixed with an equal weight of zinc oxide in a small Coors crucible and the oil burned off slowly. The crucible is then strongly heated until free from carbon. The contents of the crucible when cool are transferred in the usual way to a beaker and covered with distilled water, then 10 ml. of 10*N*-sulphuric acid are added. The beaker is warmed on a hot plate until solution is complete and the crucible is removed. The solution is made up to 250 ml., from which 25 ml. are taken and made up to 50 ml. with distilled water. This diluted solution is made alkaline, by addition of 20% Na_2CO_3 solution, becoming turbid. The solution is made slightly acid (and clear) by adding 10*N*-sulphuric acid. A further 10 ml. of this reagent, then 10 ml. of a standard molybdate solution are next added. The contents of the flask are made up to 90 ml. with distilled water and 5 ml. of a diluted stannous chloride solution are added with mixing. The 1-in. cell of a Story–Kalichevsky electric colorimeter is filled with the resulting blue solution and exactly 10 minutes after the addition of the stannous chloride the intensity of the transmitted light is determined. By means of a calibration chart the percentage of phosphorus in the sample can be calculated. G. R. N.

189. Electrometric Titration of Acids in Oxidized Petroleum Oils. A. R. Rescorla, F. L. Carnahan and M. R. Fenske. *Industr. Engng. Chem. Anal.*, 1937, **9** (11), 505.—An electrometric method using tungsten–platinum electrodes has been developed for the estimation of acids in oxidized petroleum oils. The used oil is dissolved in a mixture composed of equal parts by volume of *iso*amyl alcohol, benzene and carbon tetrachloride and saturated with lithium chloride. The base is prepared by dissolving sodium in *iso*amyl alcohol. Results for pure organic acids dissolved in solvent are reproducible within 0·2%. The average difference of the observed from the calculated values is 7%. Check determinations on used oils have a maximum deviation of 10%. A large number of solvents were examined for conductivity and oil solubility before the above combination was selected. G. R. N.

190. Simplification of Mineral Oil Tests. M. Marder. *Oel u. Kohle*, 1937, **13**, 645.—Simple relationships between density and other analytical data, previously established for petroleum and brown-coal distillates of medium boiling range (*Oel u. Kohle*, 1936, **12**, 1061), are shown to hold for distillates of lower and higher boiling ranges. The relationships are valid even for coal-tar oils. It is possible to measure directly from characteristic curves the following properties: C : H ratio, C and H contents, displaceable hydrogen $\left(H - \frac{O+N}{8}\right)$, and calorific value. It is necessary, of course, to apply different relationships according to the origin of the oil (petroleum, brown-coal or coal tar). In finding C content and calorific value of medium distillates in this way a correction factor must be applied for sulphur in petroleum oils, and for creosote in tar oils. With benzines and lubricating oils, on the contrary, C and H contents, C : H ratio, calorific value and displaceable H may be read off the density graphs without such correction.

In general, the accuracy of these methods is within the limits of ordinary analytical error. A comparison of published data on various oils of different origin showed material deviation in a few isolated cases. The author, however, found no deviation between actual and calculated data in the oils tested by him. A cracked oil (Dubbs) was placed in the brown-coal class by its density/calorific value or chemical composition curves; hydrogenated and synthetic oils conformed to the petroleum curves.

The method allowed the difference between upper and lower calorific values to be determined with accuracy. P. G. H.

191. Vacuum Decomposition of Petroleum Residues. W. L. Nelson. *Oil Gas J.*, 25.11.37, **36** (28), 62.—Laboratory tests have been carried out on the decomposition of petroleum residues at 800–850° F. under varying degrees of vacuum. With pressure of (*a*) 760 mm., (*b*) 400 mm., (*c*) 250 mm., (*d*) 40 mm., (*e*) 20 mm. and (*f*) 15 mm., the distillates obtained by cracking heavy residue consisted essentially of (*a*) kerosine and heavy gasoline, (*b*) diesel distillate, (*c*) neutral oil non-viscous, (*d*) neutral oil (300 secs. at 100° F.), (*e*) neutral oil (500 secs. at 100° F.) and (*f*) cylinder stock (80 secs. at 210° F.). From this it is apparent that the first decomposition products are

high-boiling oils, the successive products becoming progressively lighter until they can vaporize under the existent pressure and leave the zone of decomposition. At the lower pressures the yields of major products are greater than those at high pressures, owing to the less scission of the bonds, and thus the smaller are the losses. By cracking a Mid-Continent residue from a commercial lubricating oil plant of 11,000 secs. S.U. at 210° F., a yield of 72% of cylinder stock was obtained at 18 mm., whereas at 450 mm. 63% of a kerosine distillate was obtained.

The lubricating oils obtained by vacuum decomposition do not differ greatly from straight-distilled oils, although they have a tendency to oxidize readily on exposure to sunlight, depositing resin-like materials. These, however, can easily be removed by clay or acid. Such treatment is more easily and thoroughly effected than percolation treatment of regular mixed base or naphthenic products. Vacuum decomposed lubricating oils are actually superior in viscosity to normal products and had a superior bloom. C. L. G.

192. Surface Tension of Benzine. S. Valentiner. *Oel u. Kohle*, 1937, **13**, 1259.—The wire-loop method, in conjunction with a torsion balance, was applied to six benzines (special cuts with I.B.P. ranging from 50 to 120° C.) and to benzol. The surface tension of the benzines was about 20 dynes/cm. in every case, the values rising slightly with boiling point. The temperature coefficient was 0·011–0·012 per ° C. The interfacial tensions against water (40–48 dynes/cm.) showed no definite temperature relationship between 20° C. and 40° C.

The following values were found for benzol :—

T°	Surface Tension.	Interfacial Tension.
20° C	28·9	33·8
40° C	26·2	31·2

The surface tension, 34·71 dynes/cm. at 25° C., found by Mack and Bartell (*J. Amer. chem. Soc.*, 1932, **54**, 936) is regarded as too high. P. G. H.

193. Kauri Butanol Test for Solvent Power. II. E. L. Baldeschwieler, M. D. Morgan and W. J. Troeller. *Industr. Engng. Chem. Anal.*, 1937, **9** (11), 540.—As an outcome of the application of the kauri butanol test for assessing the solvent power of hydrocarbons and their mixtures, experiments were instituted on the correlation of solvent power and chemical structure. To avoid waste of material a micro-technique of determining the kauri butanol value was evolved. It was found that the solvent power (by weight) of the paraffin hydrocarbons could be expressed as $y + 0{\cdot}6x = 22$, where x is the number of carbon atoms and y is the solvent power. The results from the unsaturated hydrocarbons tested showed that the introduction of a double bond increases the solvent power for the same number of carbon atoms. The solvent power of naphthenes of the *cyclo*hexane series was given by

$$S = 42{\cdot}1 \left(\frac{6}{P+6}\right) + y\left(\frac{P}{P+6}\right),$$

where 42·1 = solvent power of *cyclo*hexane, P = number of paraffinic carbon atoms, 6 = number of naphthenic carbon atoms, y = solvent power of the paraffin having P carbon atoms. The aromatic hydrocarbons conformed to a similar equation, but the agreement in certain cases was only fair. Several instances of using the method to assess the composition of hydrocarbon mixtures are given. G. R. N.

194. Modified Distillation Method for Moisture. H. N. Calderwood and R. J. Peechowski. *Industr. Engng. Chem. Anal.*, 1937, **9** (11), 520.—In the Dean–Stark method for determining moisture the introduction of a small amount of ethyl alcohol removes water adhering to the inner wall of the condenser tube, thus increasing the accuracy of the method. The alcohol should be added only after complete dehydration, but should not be used as an indicator of complete dehydration. The boiling must be continuous and take place within the rates and periods specified. The investigation described was confined to the use of xylene as the immiscible liquid. G. R. N.

195. Self-Filling Pycnometer. G. F. Hennion. *Industr. Engng. Chem. Anal.*, 1937, **9** (10), 479.—To avoid the inconvenience of filling the pipette type of pycnometer by suction, the inhaling of vapours of obnoxious liquids under test and the trouble involved in adjusting the liquid volume, a few minor changes in construction are described. These changes render this apparatus self-filling and easy to adjust. G. R. N.

196. Low-Temperature Fractionation of Gases, Vapours and Liquids. F. N. Laird. *Oil Gas J.*, 28.10.37, **36** (24), 58.—A description is given of a small, cheap, portable and rugged type of apparatus suitable for low-temperature fractionation and analysis of gases, vapours and liquids. The principles on which the method is based are indicated, and comparisons are given of analyses determined by the use of this apparatus and by the conventional C.N.G.A. method. Results indicate that repeatability is good, that the apparatus can be satisfactorily manipulated by field testers, and that results agree reasonably well with those of the standard C.N.G.A. apparatus and method.

An apparatus of the type described can be assembled for between $100 and $200, and the time required to complete an analysis is about 1½–3½ hours. The apparatus is applicable to plant as well as field analyses. R. A. E.

197. Study of Ball Packings for Laboratory Rectifying Columns. A. R. Glasgow, Jr., and S. T. Schicktanz. *Bur. Stand. J. Res.* (*Wash.*), **1937, 19,** 593–603.—The purpose of this investigation was to ascertain the effect of (1) nature, (2) surface area, (3) size of the packing material on the efficiency, hold-up and related properties of laboratory distilling columns.

Ball type packing was selected, since (*a*) the surface area can be easily determined, (*b*) area of contact between the units is small, (*c*) distribution is fairly uniform, (*d*) volume of free space is practically independent of size of the balls.

A full description of the glass experimental column, together with the mode of operation, is given.

The test mixture used to test efficiency of separation was the binary system benzene and ethylene chloride, since the difference in b.pt. is small (3·5° C.), the vapour-liquid-phase diagram is known and the determination of composition is readily made by measurements of refractive indices.

Balls of glass 2·95 and 3·80 mm. dia.; lead 2·05 and 4·05 mm. dia.; and copper 4·00 mm. dia. were investigated, and the results were compared with those obtained with brass locket-chain packing.

The greatest efficiency of separation was shown by locket-chain and lead balls 2·05 mm. dia.

Determinations of hold-up, vapour velocity and surface area of packings were also made.

It was found that for a packing of uniform spherical balls 2–4 mm. dia. in a column 2·6 cm. dia.:—

(1) The heat conductivity and nature of packing material have no effect on efficiency of separation, liquid hold-up or throughput of still.

(2) The efficiency of separation is substantially directly proportional to the total surface area exposed in the packed column, and approximately linear with the reciprocal of the diameter of the balls.

(3) The hold-up is approximately linear with the total surface area. D. L. S.

198. Laboratory Gas-Washing or Absorption Unit. M. W. Brenner and G. L. Poland. *Industr. Engng. Chem. Anal.*, 1937, **9** (10), 480.—The Graham spiral condenser was modified to make a gas-washing unit. Features of this apparatus include the sealing of a fritted glass plate on the lower end of the condenser, increased length of travel for a given size of unit, longer time of contact for a given gas velocity and a jacket for circulating a thermostatic liquid. G. R. N.

Motor Fuels.

199. Research in Relation to the Motor Vehicle.—Fuels and Lubricants. F. H. Garner. *J. Instn. Petrol. Tech.*, 1937, **23,** 575–601.—A paper, with discussion, presented at

the Symposium on "Research in Relation to the Motor Vehicle," dealing with (*a*) fuels for petrol engines described under ease of starting, vapour lock, warming-up and acceleration, dilution, anti-knock qualities, and economy; (*b*) fuels for compression-ignition engines; and (*c*) lubricants itemized as engine lubricating oils, sludge formation, bearing corrosion, oiliness agents, oil consumption and extreme pressure lubricants.
G. R. N.

200. Trinidad Definitions for Gasoline and Kerosine. Anon. *Petrol. Times*, 4.12.37, 38 (986), 735.—In order to eliminate certain anomalies produced by Trinidad Excise (General Provisions) Ordinance of 1934, amended definitions as follows have been drawn up.

"Petroleum Oil" means a derivative of crude oil, whether manufactured by refining or otherwise, which, having a flash-point of 95° F. or more by I.P.T. test K. 7, either has a distillation end point not exceeding 330° C. by I.P.T. test G. 3, or of which 10% by volume or more distils at a temperature not exceeding 200° C. by I.P.T. test G. 3, and also any petroleum product of a description to which the definitions "petroleum spirit" and "other petroleum products" do not apply.

"Petroleum spirit" means a derivative of crude oil, whether manufactured by refining or otherwise, which has a flash point below 95° F. by I.P.T. test K. 7, and includes casing-head petroleum spirit.

An addition to the definitions is:—

"Other petroleum products" means derivatives of crude oil, whether manufactured by refining or otherwise, which have a distillation end point exceeding 330° C. by I.P.T. test G. 3, and of which less than 10% by volume distils at a temperature not exceeding 200° C. by I.P.T. test G. 3, and also any blended product which from its nature the Inspector of Mines and Petroleum Technologist is satisfied is unsuitable for use as a petroleum spirit or petroleum oil.
H. G.

201. Patents on Motor Spirit. J. C. Morrell. U.S.P. 2,098,059, 2.11.37. Refining of cracked gasoline by passing the vapour over finely-divided heavy metal, *e.g.* Cu, and adding small amounts of HCl and an aldehyde.

A. E. Buell and W. A. Schulze. U.S.P. 2,098,943, 16.11.37. Desulphurizing motor spirit in the gaseous state at 500–800° F. using as catalyst a zinc compound.

E. H. Barlow, A. P. Hewlett and P. E. Kuhl. U.S.P. 2,099,835, 23.11.37. Production of gasolines from cracked naphthas.

F. A. Howard. U.S.P. 2,099,850, 23.11.37. Improved fuel for high-compression engines operating on the Otto cycle comprising a hydro-formed oil having a flash point above 100° F. and an end point below 450° F. and inherent anti-detonant properties at least equal to those of a sweet uncracked gasoline from Mid-Continent crude, to which 40% of pure benzol has been added.

M. R. Mandelbaum. U.S.P. 2,100,011, 23.11.37. Recovery of hydrocarbons consisting of benzol, toluol and xylols from gases containing them in a relatively impure state by scrubbing the gases with high-boiling absorbent oil. The latter is then steam-distilled to remove these hydrocarbons.

See also Abstracts Nos. 146, 172, 215 and 221.
W. S. E. C.

Gas Oil, Diesel Oil and Fuel Oils.

202. Correlation of Laboratory Tests on Diesel Fuels with Service Engine Operation. W. F. Joachim. *Gas Oil Pwr. Annual Tech.*, Review Number, 1937, p. 12.—A brief review is given of some of the work done in correlating results of physical–chemical and C.F.R. engine-ignition quality tests with fuel performance in service engines at the Engineering Experiment Station of the U.S. Navy.

Twenty-five undoped fuels having a wide range of ignition qualities, etc., were tested in a Fairbanks–Morse single-cylinder, 4-cycle, pre-combustion diesel engine of 10 B.H.P. and also in the laboratory and in a C.F.R. engine. Results of thirteen fuel ignition quality indices were plotted against performance in the service engine. Results indicate that for this type of engine, measurement of maximum cylinder pressure or of computed combustion shock gives satisfactory indication of the quality

of fuel being used and that b.pt.–gravity constant, cetane number (C.C.R. method), diesel index number, viscosity–gravity constant and cetane number (K.M. delay method) could be used to predict fuel performance in service engines, but further investigations were required.

Numerous undoped and doped fuels were tested in a Winton single-cylinder, 2-cycle, 75-B.H.P. diesel engine and for the five indices mentioned above. These tests indicated that the three physical–chemical tests and the cetane number (C.C.R. method) were unreliable for predicting fuel performance in the case of doped fuels. Reasons for these failures are considered. If the C.C.R. method can be regarded as indicative of fuel starting ability, then a fuel ignition quality dope may increase the ease of starting of an engine in cold weather only about one-third as much as it increases ignition quality of the fuel with reference to ignition delay and combustion shock.

The Fairbanks–Morse engine performs best with fuels having high ignition quality (cetane number 55 or over), except that smoke density is least at a cetane number of 30. Fuel consumption decreases with increase of cetane number over a range from 30 to 60. In a Buda 16-H.P. engine fitted with an air-cell head practically no change in fuel consumption over this range was noticed, showing the effect of combustion chamber design in this respect. In the 2-cycle Winton engine increase of cetane number results in decreased fuel consumption over the range 20 to 80 cetane number. Other considerations indicate that fuels of relatively high cetane number result in best performance in both the Buda and Winton engines. R. A. E.

203. Behaviour of High and Low Cetane Diesel Fuels. G. C. Wilson and R. A. Rose. *J. Soc. Aut. Engrs.*, 1937, **41**, 343–348.—The authors have investigated the behaviour of a large number of fuels using an indicator consisting of a photo-electric pickup system connected to cathode-ray oscillograph tubes, which has been described previously in this Journal, and a $3\frac{1}{8} \times 4\frac{1}{2}$ engine of 15·64 : 1 compression ratio running at 1250 r.p.m. A large number of graphs are produced showing the effect on ignition lag of varying the time of injection. It is found that fuels of widely different cetane ratings from 24 to 100 all give practically the same ignition lag when injected near dead centre. The authors conclude that the ignition delay period for any fuel is approximately 0·001 sec. if the air is at or above the critical ignition pressure and temperature. All fuels give rough operation if injected 0·0027 sec. or more before combustion starts. The outstanding cause of ignition delay and engine roughness with low-cetane fuels is too early injection of the fuel. The time of injection should not only vary with engine speed, but it should be adjustable to suit different fuels. C. H. S.

204. Determination of the Ignitability of Diesel Oils on a Laboratory Scale. R. Heinze and M. Marder. *J. Instn. Petrol. Tech.*, 1937, **23**, 602–615.—A critical and detailed discussion of the assessment of the ignition characteristics of diesel fuels by means of laboratory tests with particular reference to the effect of a derived boiling point (the Siedekennziffer of Wa. Ostwald) on the interpretation of these tests. G. R. N.

205. Patents on Kerosene. Edeleanu Gesellschaft m.b.H. E.P. 474,892, 9.11.37. Improving illuminating oils by extracting with solvents the higher-boiling constituents of the oil fraction and mixing the raffinate with the lower-boiling constituents (which may be refined with earths) and then treating the finished product with earths.

Edeleanu Gesellschaft m.b.H. E.P. 475,255, 15.11.37. Solvent extraction of light oils using SO_2 and an auxiliary solvent—*e.g.* ethylene glycol, benzyl alcohol, etc.—to obtain fractions rich in aromatic and unsaturated hydrocarbons.
W. S. E. C.

206. Patent on Fuel Oil. R. C. Sullivan. E.P. 475,663, 24.11.37. Dehydration of wet fuel oil by heating it in stages above the boiling point of water while passing it through three narrow separating towers arranged in series. The first tower is lagged, and the other two are steam-jacketed. W. S. E. C.

See also Abstracts Nos. 199, 200 and 222.

Lubricants and Lubrication.

207. Chemical Constituents of Paraffin Base Lubricating Oils. J. Müller and E. Neyman-Pilat. *J. Instn. Petrol. Tech.*, 1937, **23**, 669–678.—An account of experiments with paraffin base lubricating oil involving acid treatment, solvent extraction and crystallization in an attempt to isolate the *iso*paraffin constituents. The results obtained indicated that only small amounts were present, and as such unlikely to have any important influence on the physical properties of the oil. G. R. N.

208. Use of Extreme Pressures in the Investigation of Lubrication. T. C. Poulter. *Oil Gas J.*, 23.12.37, **36** (32), 46.—Investigation of the behaviour of liquids and solids under pressures of up to 1,500,000 lb. per sq. in. are leading to an entirely different conception of the problems involved in extreme pressure lubrication. A pressure of 500,000 lb. per sq. in. is likely to be encountered in hypoid gears, and under these conditions some materials normally liquid may separate as solids of metallic hardness. Water in the form of an emulsion or even the normal small amount of moisture present in an oil is converted to a solid (Ice VI) at one-third or one quarter of the pressure frequently existing under extreme pressure lubrication conditions. This ice has a melting point of about 100° C. Some of the normal constituents of oils may similarly produce substances hard enough to wipe the lubricant from the surface, or even to produce abrasive action. Water or other compressed material can be shown to penetrate the surface of steel at ultra-pressures, thus causing a breakdown. Under such conditions oils of the same viscosity at normal pressure may vary several thousand-fold. It is suggested that eventually specifications of a lubricant will be largely based on the pressure–hardness curves for both the mixture and the individual components, particularly in view of the modern conception of a lubricant as a fluid serving to carry the very small quantity of material which produces a lubricating action. These curves would be theoretically determined from the hardness and curvature of the surfaces, the rate of motion of the contact point with respect to these two surfaces, the rate of motion of one surface with respect to the other, and other conditions affecting the plastic flow of the lubricant. C. L. G.

209. High Oiliness-Low Wear? G. L. Neely. *J. Soc. Aut. Engrs.*, 1937, **41**, 548–552.—This paper describes a machine, called the kinetic oiliness-testing machine, model B, designed for evaluating both friction and wear with any given lubricant.

The machine uses two sets of frictional surfaces, one in the form of a track having two concentric rails, and the other consisting of three small buttons with recessed centres and flat tracks on the outer edges. The track was of ground hardened steel, and the buttons were S.A.E. No. 64 phosphor bronze.

It is claimed that the rubbing surfaces are maintained automatically at an almost uniform degree of surface smoothness by the lapping action produced by the combined rotating and sliding motion of the buttons. The wear which occurs is entirely from the buttons, whereas the steel track shows no measurable wear in the tests. The latter were conducted at various loads and speeds using an oil temperature of 175° F. The maximum load corresponded to unit loading of approximately 750 lb. per sq. in.

The results obtained with the machine indicated that both wear and friction varied directly with the load, and that total wear reached a maximum, in some cases, at one particular speed, whereas the wear rate decreased generally as the speed was increased.

The wear rate is taken as the metal removed per unit of linear surface rubbed. It was also found that no direct relation existed between wear and friction. Thus the addition of certain compounds to lubricating oils was examined, and in some cases the wear was reduced to a far greater degree than was the friction, and in other cases the reverse effect was obtained. Two lubricants gave extremely small amounts of wear, although their friction-reducing properties were poor.

A new term coefficient of wear is proposed. This is obtained by dividing the total wear by the load and by the distance travelled by the buttons. The latter factor is necessary, since in all cases wear occurred continuously as a function of time.

In a discussion following this paper the author's general observations were confirmed by some speakers. W. E. J. B.

210. Quality of Lubricants from Mid-Continent Sources. S. Born. *Nat. Petrol. News*, 1.12.37, **29** (48), R. 354.—Sundry authorities are quoted on the importance of sundry relative laboratory characteristics of lubricating oil in relation to performance in service. There appears to be little agreement of opinion. It is pointed out that the initial characteristics of viscosity, viscosity-index, flash point, gravity, volatility, etc., suffer drastic modification by only short service. Data are submitted which indicate that lubricants from Mid-Continent sources are of satisfactory quality, and that their low Conradson carbon yields are in line with relatively low consumption in use. H. G.

211. Patent Literature in Refining Technology. J. H. Byers. *Nat. Petrol. News*, 1.12.37, **29** (48), R. 359.—The article presents a digest of the current patent literature dealing with those synthetic or modified naturally occurring bodies which are used as addition products to mineral lubricants for the purpose of improving one or more relative characteristics. It is suggested that the ever-increasing bulk of this literature indicates how important this department of petroleum technology may become in the future. While entirely synthetically produced lubricants may not yet be within the realm of practical politics, the indications are that they are an almost certain future achievement. The present tendency is to get away from those bodies of non-petroleum origin. Sulphur, halogen and certain aromatic derivatives have not the requisite stability, and tend to decompose in service with the production of dangerously corrosive bodies. The brief description of the more important current patents which is published indicates that Edeleanu extracts, modified paraffin wax, the bodies removed by clay-contacting, naphthalene, gas polymers, etc., are all in use as the source of agents used as pour-point depressants, improvers of colour and bloom, viscosity and oiliness characteristics, etc. H. G.

212. Suitability of Vegetable Oils for the Production of Consistent Lubricants. E. Galle and W. Friedl. *Petrol. Z.*, 10.11.37, **33** (44), 9.—The results of the work described show that blending of rapeseed, soya-bean and castor oil with mineral oils to produce consistent greases, is not recommended. W. S. E. C.

213. Patents on Lubricating Oil. N.V. de Bataafsche Petroleum Mij. E.P. 474,885, 9.11.37. Production of lubricating oils by polymerizing alkenes which are gaseous at normal temperatures and pressures, *e.g.* butenes, propenes, at temperatures above 125° C. and under pressure, the catalyst being aluminium chloride. A low-viscous fluid is obtained consisting chiefly of gasoline hydrocarbons and the higher-boiling portions are separated and further polymerized under lower pressures and at temperatures below 125° C.

Pennsylvanian Petroleum Research Corpn., and A. H. Stevens. E.P. 474,971, 5.12.37. Apparatus for contacting liquid phases.

J. E. Pollak. E.P. 475,026, 8.11.37. Production of white oils for use in internal-combustion engines by acid-treating mineral oils together with 0·2–1% of fatty oils at 30° C.

F. Neukom. E.P. 475,040, 8.11.37. Lubricant consisting of colloidal graphite in lubricating oil incorporating benzole and *cyclo*hexanol in the oil-graphite suspension.

Socony-Vacuum Oil Co., R. C. Moran, W. L. Evers and E. W. Fuller. E.P. 475,445, 19.11.37. Lubricant for bearings consisting of a solvent-refined oil and 0·10–0·50% of tribetanaphthyl phosphite.

N.V. de Bataafsche Petroleum Mij. E.P. 475,692, 24.11.37. Solvent extraction of lubricating oil using liquid SO_2, furfural, quinoline, etc.

Edeleanu Gesellschaft m.b.H. E.P. 475,723, 22.11.37. Deasphalting of hydrocarbon oils by treatment with a fluorine compound of a chlorinated or brominated aliphatic hydrocarbon in which the number of fluorine atoms is less than the number of atoms of other halogens. The resulting solution is then treated with phenol, furfural, etc.

Continental Oil Co. E.P. 475,787, 22.11.37. Improving the film strength of petroleum oils and hydrocarbon greases by dissolving therein one or more aryl esters of phosphorus.

P. C. Keith, Jr. U.S.P. 2,097,728, 2.11.37. E. M. Dons and D. B. Mapes. U.S.P. 2,097,999, 2.11.37, and 2,098,007, 2.11.37. B. Hopper and K. Kingman. U.S.P. 2,098,545, 9.11.37. Propane dewaxing.

C. F. Tears. U.S.P. 2,098,766, 9.11.37. Method of recharging a pressure filter in propane dewaxing.

C. D. Barnes and M. T. Flaxman. U.S.P. 2,099,190, 16.11.37. Dewaxing hydrocarbon oils using cholesterol and a diluent.

W. B. McCluer and M. R. Fenske. U.S.P. 2,099,615, 16.11.37. Solvent extraction of hydrocarbon oils using phenyl ethyl alcohol.

C. R. Reeves and C. R. Gentry. U.S.P. 2,099,824, 23.11.37. Apparatus for purifying oil.

C. C. Buchler and J. M. Page, Jr. U.S.P. 2,100,099, 23.11.37. Solvent refining of hydrocarbon oils using dichloroethyl ether.

U. B. Bray. U.S.P. 2,100,429, 30.11.37. Solvent extraction of lubricating oils using SO_2-benzol, *o*-chlorophenol, etc.

A. Lyman and M. M. Holm. U.S.P. 2,100,662, 30.11.37. Dewaxing hydrocarbon oils by dissolving together oil, a wax crystal conditioner in the form of 1% by weight of pitch obtained by distillation of acid-treated tar from cracking processes and a hydrocarbon solvent which is liquid at normal temperatures.

S. S. Bhatnagar. U.S.P. 2,100,707, 30.11.37. Solvent refining of hydrocarbons using glacial acetic acid.

E. F. Pevere. U.S.P. 2,100,915, 30.11.37. Dewaxing hydrocarbon oils using organic esters, *e.g.* ethylene glycol distearate or mannitan tetrastearate.

E. F. Pevere and C. G. Ludeman. U.S.P. 2,100,916, 30.11.37. Dewaxing of hydrocarbon oils using acetone-benzol and a wax crystal modifying material which is a product obtained by esterifying a hydroxystearic acid with a higher saturated fatty acid. W. S. E. C.

See also Abstracts Nos. 199 and 215.

Asphalt and Bitumen.

214. Patents on Asphalt. A. B. Culbertson, Jr. U.S.P. 2,099,434, 16.11.37. C. P. McNeil and S. A. Montgomery. U.S.P. 2,099,448, 16.11.37. Blowing petroleum residues to produce blown asphalts. W. S. E. C.

Special Products.

215. Synthetic Products from Petroleum. G. Egloff. *J. Instn. Petrol. Tech.*, 1937, **23**, 645–668.—A lecture, in which the following are discussed; polymerization to produce gasoline, *iso*-octane, lubricating oils and resins, dehydrogenation, alkylation, cyclization, isomerization, oxidation, halogenation and solvent extraction. G. R. N.

216. Petroleum Wax: Determination, Analysis and Composition. D. S. McKittrick, H. J. Henriques and H. I. Wolff. *J. Instn. Petrol. Tech.*, 1937, **23**, 616–641.—An account of the development of an ethylene dichloride method for determining oil in wax and wax in oil and of an extensive study of the composition of petroleum waxes involving fractional crystallization from the same solvent. G. R. N.

217. Patents on Wax. L. H. Macomber. U.S.P. 2,099,213, 16.11.37. Improved shaping of paraffin cakes.

A. B. Gauschemann. U.S.P. 2,099,603, 16.11.37. Wax sweating oven.

S. W. Ferris, W. F. Houghton and H. C. Cowles, Jr. U.S.P. 2,099,683, 23.11.37. Production of wax fractions by sweating.

A. D. David. U.S.P. 2,100,070, 23.11.37. Manufacture of black wax.
W. S. E. C.

218. Patent on Special Products. L. E. Wesselmann. U.S.P. 2,098,713, 9.11.37. Apparatus for reconditioning cleaning solvents. W. S. E. C.

Detonation and Engines.

219. Solving Muffler Problems on Large I.C. Engines. Anon. *Petrol. World* (LA), 1937, **34** (4), 79.—Short article illustrating and describing methods for damping noise and dissipating the heat from the exhausts of large internal-combustion engines. Exhaust arrangements are shown which, in addition to performing these two objects, assist in cooling or warming—as desired—the air inside the building by utilizing the force generated by the exhaust gases to produce a jet action which draws in air through a jacket assembly around the exhaust pipe and muffler. W. W.

220. Nohab Motor Driven Railway Cars. B. Sjölin. *Tekn. Tidskr.*, 18.12.37 (Mekanik No. 12), 145–156.—Describes the construction of various types of Rail Buses for adoption by the Swedish State and also certain privately owned railways in order to modernize and cut cost of operation to compete with automobile traffic. As a result of considerable experimentation, Messrs. Nydqvist och Holm AB. (Nohab) have developed Standard wagon types, one principally for passenger transportation, equipped with two 6-cylinder Penta-Hesselman engines, 110 H.P. at 1800 r.p.m. and total cylinder volume 9 litres per engine, and a second type for locomotive purposes, equipped with two 6-cylinder Nohab-Hesselman engines, 250 H.P. at 1200 r.p.m. geared up to 200 r.p.m. with a total cylinder volume 26·3 litres per engine. In both cases power transmission is hydraulic. These motor-driven railway cars are intended for use in Sweden as well as for export. R. F. S.

221. Engine Starting with Gasoline–Alcohol Blends. N. Ishii. *J. Fuel Soc. Japan*, 1937, **16** (180), 79.—The inflammability of resultant air–vapour mixtures made by equilibrium air distillation of gasoline or gasoline–alcohol mixtures was measured using a Sligh–Bridgeman apparatus. The lowest inflammation temperatures were also recorded using gasolines with various A.S.T.M. 10% points and the same gasolines mixed with 10% ethyl alcohol at an air–fuel ratio of 1 : 1. Graphic representation of these results and of some previous determinations on pure hydrocarbons showed that almost equal ease of engine starting would be obtained when using a gasoline or its 10% alcohol blend. G. R. N.

222. Diesel Vehicles and their Fuel. G. Yuasa. *J. Fuel Soc. Japan*, 1937, **16** (179), 73.—The Hitachi 4-cylinder diesel engine, cylinders of 110-mm. bore, 140 mm. stroke, 5·3 litres swept volume, weight, 5 kgm. per B.H.P., rated at 95 B.H.P. at 2200 r.p.m., M.E.P. 7·8 kgm. per sq. cm., compression ratio 16·5 to 1, was tested on the bench against a Ford V8 gasoline engine of the same power output. The fuel consumption was 170 gms. per B.H.P. hour, as against 270 gms. for the gasoline engine. Tested on a truck assembly over roads of different gradients, the diesel vehicle showed a saving of about 80% in fuel costs. Inspection data on two oils suitable as fuel for the Hitachi engine are given. G. R. N.

See also Abstract No. 202.

Coal and Shale.

223. Coal and Future Power. Anon. *Fuel Econ.*, 1937, **12** (145), 481–483.—On the findings of a German statistical body is based a survey of the world power resources. Statistics of present known oil deposits and rate of consumption indicate that they will be exhausted in twenty years. Coal resources afford 3730 years of world consumption at present rate.

A table illustrates the derivation of power from 1913 to 1935. In 1935 world power was derived: coal 56·6%, lignite 3·7%, oil 16·5%, natural gas 3·8%, wood 12·8%, water 6·6%. From 1932 to 1935 a decline in the amount of power from coal has been checked, oil shows a gain of 1·3%, wood a loss of 2%, and water a gain of 0·5%.

The main coal deposits, their yearly production and possible life are tabulated, as also is the development of coal production in various countries between the years 1913–35.

From the analysed data is drawn a concise picture of the state of power production. The oil industry has as its chief outlet the automobile engine, so that rather than being a dangerous competitor, oil has built up a potential market for coal products. The article is generally optimistic for the future of the coal industry. T. C. G. T.

224. Another Carbonization Plant. Anon. *Fuel Econ.*, 1937, **12** (145), 464–468.—An outline of Messrs. Catalyst's projected installation for low-temperature carbonization. It is claimed that this process differs from others in that it produces only such by-products as are commercially valuable and easily disposed of. These products, apart from semi-coke, consist entirely of spirit, cresylic acid, and surplus high calorific gas. The two main variations from usual L.T.C. practice are: first, that the coal is carbonized mixed with half its weight of recycle oil; and second, the catalyst treatment of the total middle oil (b.pt. 200–320° C.) from the retorts.

Diagrams of the lay-out of the plant are given, and a fairly complete course of the processing is outlined. Types of yield indicated by the experimental plant for a commercial plant treating a charge of 200 tons of coal and 100 tons of oil are:—

	Black Vein Coal. Risca Colliery.	Mickley Colliery.
Semi coke (tons)	157·5	144·
Refined spirit (galls.)	1,600·	2,800·
Pale cresylic acid (galls.)	360·	650·
Residual heavy fuel oil (galls.)	925·	1,800·
Gas (cu. ft.)	856,000·	940,000·

T. C. G. T.

225. Recent German Carbonization Developments. D. Brownlie. *Fuel Econ.*, 1937, **13** (146), 506 and 502.—An earlier article, describing the "Brennstoff-Technik," the "Berg" and the "Hinselmann" processes, is completed by a description of the "Krupp-Lurgi" and the "Otto" processes, the former being illustrated by a photograph.

The "Krupp-Lurgi" utilizes vertical intermittent, externally-heated steel retorts for the low-temperature carbonization of bituminous coking coal, so that swelling of the charge results and considerable internal pressure develops. A special heat-resisting Krupp steel is used. Four of these plants are in operation, two of which have capacities of 35 tons per 24 hours each.

The "Otto" process utilizes vertical externally-heated, intermittent firebrick retorts, rectangular in cross section and containing a series of cast-iron divisions, dividing the charge vertically and transversely into a series of relatively narrow layers. At present only two large-scale experimental plants appear to be in operation.

In conclusion, brief mention is made of the "Von Haken" process still in the ex-

perimental stage, which carbonizes pulverized coal at a pressure of 220–290 lb. per sq. in., and of the "Koller" process, which adopts the vertical continuous retort, heated internally by gas to temperatures of about 540° C. T. C. G. T.

226. De-Dusting of Coal. Anon. *Fuel Econ.*, 1937, **12** (145), 470 and 476.—The development of these processes in America is of growing interest to the coal industry and fuel-appliance engineers. Two systems are in favour—namely, oil spraying and calcium chloride treatment. The latter treatment involves spraying with a solution of 15–18% calcium chloride in water, at a pressure of up to 300 lb. per sq. in., 1½ to 9 lb. of calcium chloride per ton of coal are required. Magnesium chloride and sulphurous acid improve the wetting properties of the solution, but such additions increase the corrosive possibilities. The cost of a plant capable of treating 200,000 tons of coal per year is £1400, and the treatment cost varies from 2½*d.* to 7½*d.* per ton. Coal so treated commands a premium of 5*d.* to 1*s.* per ton.

Oil spraying is in growing favour, and the Fuel Research Station have evaluated several oils. Heavy fuel oils and low-temperature tars were found unsuitable, but a proprietary "coal-spray oil," available in bulk in this country at a provisional price of 8½*d.* per gallon, was found to be very effective. The oil is sprayed at pressures of up to 600 lb. per sq. in., 5–7 lb. of oil per ton of coal are required, and the cost is normally under 6*d.* per ton.

The effect of oil treatment lasts several months, and coal dust-proofed with oil is said to be economical in use. T. C. G. T.

227. Preparation of Raw Gas for the Fischer Synthesis. M. Tukei. *J. Fuel Soc. Japan*, 1937, **16** (181), 87.—The Fischer synthetic gasoline plant under construction at Miike colliery will process gas made from Miike coal. Because the latter is of the strongly caking type, the usual direct gasification method has proved difficult. The raw gas is prepared, therefore, by mixing coke-oven gas and water gas, which is produced from the coke made in a Koppers coke-oven. The coal gas is subjected to methane cracking in a vertical stove. The Koppers oven is of the circulation type heated by the producer gas made from powdered coke, and the heat source for methane cracking is provided by the waste gas from the Fischer process. Analytical data on the gases produced by this method are given. G. R. N.

228. Japanese Briquette Industry. M. Yoshimura. *J. Fuel Soc. Japan*, 1937, **16** (180), 80.—For 1935 Japan ranked third in the list of briquette-manufacturing countries of the world, the output being 1,500,000 tons. For industrial purposes, *e.g.* railways using steam locomotives, the composition of the briquette is 40–45% anthracite, 50–55% bituminous coal and 7–8% pitch. The latter binding material is required to have 5–10% free carbon and a softening temperature of 60–70° C. Starch or vegetable glue is used as the binding material for briquettes for domestic purposes. Specification tests for briquettes are given. G. R. N.

229. Treatment of Japanese Coal Tar. Y. Karasawa. *J. Fuel Soc. Japan*, 1937, **16** (179), 71.—At the Kokyo Gas Co. refinery the crude tar is dehydrated in cascade type units, then separated by distillation in vertical and horizontal stills into naphtha oil, light oil, two creosote oils and pitch. These primary fractions are treated by conventional methods to give 90% benzol, toluol, three naphthas, phenol, cresols and naphthalene. Brief tabulated data are given. G. R. N.

Economics and Statistics.

230. Chronicle of the Petroleum Industry of the U.S.S.R. I. Ganitzki. *Monit. Petr. Roum.*, 1937, **38**, 1633–1635.—A survey of the electricity development of the U.S.S.R., particularly that of hydro-electric plants. The increasing output is illustrated and prospective development outlined. High-tension cables carrying 220,000 volts are being laid. Electrical energy produced according to the 1937 programme was 40,500,000,000 kw.-hours, which compares with a 1913 output of 1,945,000,000.

According to plan, Russia is using less coal and oil for the production of electricity.

A table illustrates the source of energy for the last 24 years, and it appears that petroleum only supplied 4·1% in 1937, compared with 60% in 1913. Apart from the substitution of coal and oil by such materials as bituminous shales, peat and combustible refuse, hydro-electric plants are being rapidly developed. T. C. G. T.

231. Rationalization of the Consumption of Fuel—Chronicle of the Petroleum Industry of the U.S.S.R. I. Ganitzki. *Monit. Petr. Roum.*, 1937, **38**, 1715–1717.—An analysis of the consumption of fuel by the U.S.S.R. industry indicates that coal consumption has increased from 44,000,000 tons in 1908 to 142,000,000 tons in 1935. In the latter year 71·9% of the consumption was by furnaces, etc., and 26·7% by chemical processes such as coke production and metallurgy. The rapid industrialization of the country will increase the latter figure, and notice is being taken of the fact that much excellent coking coal is being used in furnaces. Greater use is being made of anthracite.

The use of heavy oil as a furnace fuel has rapidly declined with the advent of cracking and hydrogenation. Where possible, the fuel is replaced by other fuels such as bituminous shales and peat, or else electric power is adopted. This campaign to conserve heavy oil for cracking and for lubricating oil production is reflected in the figures for the consumption of heavy oil, as fuel, over the past five years, when, despite the great industrial developments, the amount of fuel oil consumed has remained fairly constant at about 9,000,000 tonnes.

The branches of industry consuming this oil are analysed, and the steps taken to reduce their consumption are recorded. T. C. G. T.

BOOK REVIEWS.

Oil Fuels and Burners. By James A. Moyer. Pp. ix + 375. Figs. 240. McGraw-Hill Publishing Co., Ltd., London. 1937. Price 24*s*.

This book covers a wide field in connection with oil burning, and, in accordance with the practice that has now become general in America, books of this kind appear to contain a large amount of matter connected with what is strictly the province of heating and ventilating.

The subject-matter, as far as it concerns oil-burners, is set out in an interesting fashion, with many excellent illustrations. It is a pity, however, that a large number of misleading statements are made, whilst in some instances the inaccuracies are disconcerting, to say the least of them.

For instance, a table of the coefficient of expansion of oil is given in which the figures are ten times too high, due to the decimal point being misplaced.

Under the heading of "Oil Pressure for Atomization," Chapter XI, it is stated that the amount of pressure given by an ordinary centrifugal type of ventilating fan is quite inadequate for the discharge of oil through a nozzle.

These two cases may be associated with some slip on the part of the author in his typographical text, but other errors throughout the book can hardly be explained on that basis. For instance, the average temperature in oil-burner furnaces is stated to be 2000° F., with a figure as low as 1200° F. being mentioned. This may, of course, be argued to a certain extent, since so much will depend on where the oil-burner furnace is supposed to end, but if—as most people will assume—it represents the combustion zone in the region of the flame, it is generally accepted that 2000° F., and certainly 1200° F., would be abnormally low.

Other statements to which exception could be taken are fairly numerous throughout the book, whilst the descriptions of appliances are frequently so brief as to be unintelligible except possibly to an expert.

The chapters on heating are interesting, but refer almost entirely to steam systems which are not so widely used here as in America.

The book is printed in an excellent manner, with illustrations that are clear and easily followed.

I. LUBBOCK.

Oil Burners. By Kalman Steiner, Ch.E. Pp. xvi + 436. Figs. 213. McGraw-Hill Publishing Co., Ltd., London. 1937. Price 25*s*.

Quite a number of books on oil-burners have recently been written, and in most cases there are signs that authors have not studied their subject sufficiently. The science of oil-burning appears at first sight disarmingly simple, until some of the complicated phenomena are studied carefully.

Mr. Steiner is to be congratulated on having written a book which is lucid and satisfactory. Burners are described clearly, with excellent diagrams, and the fundamental principles of most of the different types are set out in a manner which is easy to grasp.

There are one or two features where we might join issue with Mr. Steiner in the light of modern practice, particularly in connection with combustion-chamber designs, but for the student most of the burner arrangements described should be satisfactory as a guide to the usual dispositions. We dislike, and do not usually recommend, burners firing through comparatively uncontrolled open ports in boiler furnaces such as those shown in Figs. 172 and 173.

Another matter where we feel the author has gone wrong is in his remarks on the effect of sulphur in oil when used for melting metals or for baking pottery. Far too much has been made of this effect, when in actual practice the sulphur content of an oil is of no importance whatever for nearly all the metal-melting work in industry with the possible exception of nickel or nickel alloys.

In accordance with usual American practice, the author describes the buried storage tank and the basement storage tank with brick enclosure and sand fill. It is a great pity that people dealing with fuel oil in the United States have dis-

seminated recommendations for this type of storage tank, sometimes slavishly copied in other parts of the world. The buried storage tank is usually extremely unsatisfactory for fuel oil, particularly the heavier grades, since sludge cannot readily be removed, nor can the tank be cleaned internally without considerable difficulty. We prefer the above-ground tank wherever possible, but where it is required underground, it should always be in a pit sufficiently large to give access around the tank both for sludge removal and for entry in the event of cleaning being necessary.

On the whole we can recommend this book, which will repay study by every serious student of the subject. The illustrations are excellent. I. LUBBOCK.

Gestaltungskräfte der Energiewirtschaft. By Dr. Günter Hünecke. Pp. vii + 195. Diagrams 12. Verlag von Felix Meiner, Leipzig. 1937. Price R.M. 11.50.

This book deals in an adequate manner with the world situation regarding the production and consumption of energy produced from coal, petroleum and water power. A detailed statistical study is made of the supply and consumption of the chief forms of power, such as electricity and gas, produced from the primary sources of energy. Consideration is also given to the reserve supplies of power, and with the help of tables and charts the reader obtains a clear picture of the recent developments of these supplies and future possibilities in various parts of the world.

With regard to petroleum, which receives full treatment, there is a useful map showing statistically the total oil production, up to the end of 1935, in various parts of the world. On the same chart are shown the known oil reserves and the estimated reserves as given by official sources at the end of 1935. These estimates of reserves have since been modified in a number of cases, but the general picture given is useful.

Tables and charts are given showing the output of petroleum and its products in each country from 1913 to 1936, and it is interesting to follow the development of the production in various countries. The consumption of oil products per 1000 inhabitants is shown in a map of the world which also shows the production, so that the imports and exports of oil for each country can be seen at a glance.

Data are given for coal and oil production, and the consumption of these products in shipping in recent years are compared.

Reference has been made to some of the subjects which are most likely to interest the petroleum technologist, but, taking the book as a whole, the voluminous data are presented in a form which makes them easily digestible, and should therefore be of great value to the reader. The book also contains an extensive bibliography of the subject, but most of the references are to German sources.

W. W. GOULSTON.

BOOKS AND PUBLICATIONS RECEIVED.

Practical Petroleum Engineers' Handbook. By J. Zaba and W. T. Doherty. Pp. vi + 401. Gulf Publishing Co., Houston, Texas. 1937. Price $5.00.

The authors have endeavoured to combine in handy form a large amount of tabulated data with formulæ and charts arranged under the following headings :— General Engineering Data, Steam, Power Transmission, Tubular Goods, Drilling, Production, Transportation.

The tables, formulæ and figures shown are practical rather than theoretical in nature, and should materially assist in the rapid solution of everyday problems in the oil industry.

Report of the Road Research Board for the Year Ended 31st March, 1937. Pp. 118. Index, 119–120. Figs. 75. Tables 21. H.M. Stationery Office, London. Price 3*s*.

This Report describes the large variety of work which is being carried out on the problems of road construction and use.

With regard to skidding, it has been shown that the skidding characteristics of road surfaces are largely determined by the total area of contact between the tyre on the road and the number of isolated individual points of contact in this area. An examination of the texture prints taken from roads known to be very slippery has shown that on these surfaces the tyre makes contact with the road over almost the entire area of the ellipse of contact, whilst the number of individual contacts in this area is small. Prints from roads having high sideway force coefficients showed that the area of actual contact of tyre and road within the ellipse of contact was appreciably less, whilst the number of individual contacts within the ellipse was much higher. Tests on a number of granite sett surfaces appear to indicate that grouting between the setts with cement mortar instead of bituminous material increases the resistance to skidding.

Further progress has been made in the development of a machine for indicating and measuring irregularities on the surface of a road, and considerable progress has been made in the study of road foundations. The springs of 1936 and 1937 being unusually wet led to an exceptional number of failures in embankments and cuttings. Laboratory analyses have been made of undisturbed specimens of the soil taken from the sides of such failures, and in many cases this work has enabled the causes of the failure to be traced and explained.

Further experiments have been conducted with the "aggregate vibration method" of concrete control, and an extensive trial of this method is being made by the County Engineer of Surrey during the construction of the Mikleham by-pass road.

In connection with bituminous materials, tests have been devised and tried out for examining the physical properties of mixtures of binder and stone. By such tests it should eventually be possible to assess the value of the bitumens and tars, as also the stone, for making roads, and to arrive at the best proportions and conditions for laying the materials on the road. Attention has also been given to the setting of tar macadam during storage, the displacement of tar films on stone by waters of varying acidity, and the treatment of stone for surface dressing.

Der Steinberg-Dom bei Zistersdorf und Sein Oilfeld. (The Rocky Mountain Dome of Zistersdorf and Its Oilfield.) By Karl Friedl. Reprint from the F.E. Suess-Festschrift der Geologischen Gesellschaft in Vienna, 1936. Volume 29. Pp. 290. Plates 4. Verlag für Fachliteratur G.m.b.H., Vegagasse 4, Vienna 19/1. Price, Schilling 20.

The Zistersdorf oilfield is the first and at present the only producing oilfield in Austria. It is by far the largest oilfield which has been discovered in the geologic unit of the Vienna Basin, and is the first to be discovered in Middle Europe solely on the basis of geological research work, without surface oil indications. In this report the author describes in detail the producing area of the Rocky Mountain Dome, and then proceeds to a description of a considerable part of the Vienna Basin. The chief object of the publication is to place at the disposal of science the information yielded by recent borings, in order to promote the opening up of further oilfields which are certain to be present under similar geologic formations in other parts of the Vienna Basin. The preponderant part of the production from the Zistersdorf oilfield arises from the sandy sediments of the Upper Miocene strata, in which no fewer than twelve producing oil horizons have already been detected.

Gasoline Surveys for 1935 and 1936. P. V. Rosewarne and H. McD. Chantler. Pp. 40. Canada Department of Mines and Resources, No. 787. Price 25 cents.

The Division of Fuels of the Bureau of Mines has made, at the Fuel Research Laboratories, a continuous study of the gasoline sold in Canada for the past twelve years, and annual reports have been prepared from the results obtained. During the early part of August 1935, 179 samples of gasoline were collected, and during the early part of August 1936, 180 samples were collected from the wholesale dealers and distributors in fifteen cities. This report contains the results in detail of the analyses of these 359 samples of gasoline.

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Geology.

232. Volume Relations in Open-space Replacements. G. E. Anderson and C. A. Merritt. *Bull. Amer. Ass. Petrol. Geol.*, 1937, **21**, 1486–1493.—As shown and proved by Lindgren and others, metasomatism of the igneous and metamorphic types rarely if ever causes change of volume. This notion has not been directed to chemical reactions which prevail in open-space. Many references in geological literature exist in connection with supposed volume changes under such conditions, as, for example, the alteration of anhydrite to gypsum and of olivine to serpentine. These, and other examples, have resulted in volume changes, according to various authorities.

The object of the present paper is to examine the evidence on which these statements rest. The writers' investigations were carried out in two phases: (1) a review of the physical and chemical factors involved in the process, and (2) a review of the geological evidence. This work has now led to the writers concluding that replacement takes place in open space as well as in solid rock without change in volume.

G. S. S.

233. Major Divisions of Permian in Oklahoma and Southern Kansas. D. A. Green. *Bull. Amer. Ass. Petrol. Geol.*, 1937, **21**, 1515–1533.—In this paper major lines in Oklahoma and Kansas are used to divide Permian sediments into natural time divisions; these divisions are shown graphically.

The region extends from Arbuckle and Wichita Mountains northward into Kansas. In this northern Permian basin the beds are lenticular and gradational, and compared with the southern basin it has its separate geological history and consequently its separate sedimentary units. Each basin also having different sedimentary facies at different localities within one basin, no correlation is attempted by the author with the two areas.

There are no type localities of the three divisions, as they represent time units rather than lithological units. The names employed are Wanette, Minco, and Upper Red Beds.

In Central Oklahoma the Wanette division includes the sediments from the top of the Brownville limestone and extends upwards to the top of the Stratford Shale (Herington limestone). It is not possible to trace northern boundary lines through Central Oklahoma owing to gradations within the Wanette. Various uplifts of the shore-line on the east resulted in the delta formed in front of the shore extending

farther west than the next older deltaic sediments. These uplifts caused unconformities which shortened the shoreward sections.

The Minco division extends from the top of the Stratford Shale to the base of the Matlow formation. A figure is given showing the gradations which occurred within the Minco. Towards the close of this period, regional warping and some local folding took place, which were followed by peneplanation.

The Upper Red Beds division begins at the base of the Marlow, and extends upward to the Tertiary overlap above the Elk City sandstone. This, as shown in a section, includes the Whitehouse Group and the Quartermaster, which is also considered as a group. The writer here corrects his former classification of the Cloud Chief with the Quartermaster, and, in agreement with recent work by Noel Evans, classifies the Cloud Chief as the upper member of the Whitehouse group. An interesting and peculiar feature of the Cloud Chief is that in certain areas large amounts of gypsum are present, while in intervening areas this material is practically absent. Such an unequal distribution shows that variable conditions prevailed in the basin during the deposition of the Cloud Chief formation.

The paper concludes with a discussion. G. S. S.

234. Unconformity at Base of Whitehorse Formation, Oklahoma. O. E. Brown. *Bull. Amer. Ass. Petrol. Geol.*, 1937, **21**, 1534–1556.—In the vicinity of the Anadarko basin is found some of the most complicated surface geology of Oklahoma. Deposition of almost every type has taken place in the area, and much consideration in the past has been given to the many phases relative to materials, source, and existing conditions, both in the field and laboratory. The result of detailed plane table work is now given in the present paper.

A study of the various stratigraphical formations (including the Duncan sandstone, Blaine-dog Creek, and Whitehouse) leads to the conclusion that an overlapping unconformity occurs at the base of the Marlow member of the Whitehouse. In this area, also, an error is proved to exist on the State geological map of Oklahoma.

G. S. S.

235. Submarine Pacific Coast Petroleum. Anon. *Rev. Petrolif.*, 7.1.38 (767), 17–18.—It is probable that large reserves lie below the Pacific Ocean all along the North American coast. In California certain fields, such as Huntingdon Beach, Elwood and El Capitan, have given submarine production, and it is certain that many more will be found. In the coastal regions of Alaska, Oregon, Washington and Mexico little is known of the detailed geology, but there too possibilities exist. R. O. Y.

236. Tintea—One of the Most Interesting Fields of Roumania. Anon. *Petrol Times*, 5.2.38, **39** (995), 173–174.—This field, which has assumed new importance through the discovery of prolific deep horizons last year, was discovered in 1901. Production was from the shallow northern flank of a diapiric salt fold, and later from the deeper southern flank, in both cases from Dacic sands. Finally in 1937 the Meotic sands on both flanks were proved to be highly productive. A geological section is given. The two companies controlling the field have agreed to adopt conservative measures, and there will be no competitive drilling. At Paulesti, an easterly extension of Boldesti, there has been success, and it is expected that these two new fields will steady Roumania's production during 1938. R. O. Y.

237. Prospecting in the Foreland of the Roumanian Oil Region. I. Basgan. *Bohrtech. Z.*, 1937, **55** (11), 309–313.—There are a number of promising areas. In the Siebenbürger (Transylvanian) Basin it is hoped to find oil below the gas horizons. The Marmaross district in the north and the Carpathian foreland in Moldavia are other prospective regions. In the Flysch zone the oil horizons are principally in the Eocene, in the marginal zone of the Flysch they are in the Eocene and Oligocene, whilst to the south of the central Carpathians the Meotic and Dacic (Miocene) are the most productive horizons in Roumania. Their continuation southwards forms the foreland which reaches to the Danube.

Recently two new areas have become noteworthy, Buçsani and Margineni-Olari. Both fields are some 6–10 km. south of Moreni-Gura Ocnitzei. The Bucsani anticline

has a diapiric form with Helvetian and salt in the core and Meotic, Pontic and Dacic above. There are three oil-sands in the Meotic. The anticline has a general east-to-west trend, with a slight swing to the north-east, and plunges to the west. The Buçsani crude has a paraffin base and a sp. gr. varying between 0·806 and 0·850.

The Margineni field is not so well known, and the possibility exists that it may extend beyond its present limits.

Gravity surveys made by the Geological Institute, and supplemented by the work of the oil companies, have shown several anticlines in the foreland of the oil region, along a zone south of the line Ploesti-Targoviste. A number of test wells have as yet given no positive results. S. E. C.

238. Salt Waters in the Roumanian Oil Deposits. P. Petrescu. *Monit. Petr. roum.*, 1938, **39**, 25–29.—In Roumania natural gas and oil are nearly always accompanied by water containing dissolved salts, even in non-marine deposits like the Upper Pliocene. Strata in which oil is scanty or absent also contain brackish water.

These subterranean or magmatic waters come from (*a*) water imprisoned in sediments, (*b*) water set free from mineral colloids, (*c*) water from the decomposition of animal or vegetable remains, and (*d*) water of crystallization set free. It has often been set free from its original position by pressure, and, like oil, has accumulated in porous rocks. It is impossible to say that water found in any spot has originated there, and in its history any accumulation will have suffered considerable chemical change from recrystallization, base exchange, etc.

The chemical composition at any time is the result of an equilibrium reached between the various influences of substances with which water is in contact.

The salts found in these subterranean waters are the same as those found in the sea, but the proportions are different. Iodine is always more abundant in subterranean waters, coming from organic sources, and a very high content probably indicates that the water has passed through several deposits high in organic remains. The total salinity is usually higher than that of the ocean, rarely less, and occasionally as high as 30%.

In subterranean waters in contact with oil supplies are found certain characteristics; *e.g.* a complete absence of sulphates, the presence of naphthenates, or a higher proportion of ammonium salts. The absence of sulphates is a sign that the water is, or has been, in contact with oil.

However, sulphates are occasionally found in water from oil deposits. The process of reduction is very slow, and in these cases has not yet been completed, or the intrusion of the water may be recent.

The abundance of naphthenates is correlated with the degree of oxidation of the oil, very slight indeed in oligocene beds, and progressively greater in more and more recent formations. W. E. J. B.

239. Evaluation of Petroleum in Oil Sands by its Index of Refraction. H. D. Hedberg. *Bull. Amer. Ass. Petrol. Geol.*, 1937, **21**, 1464–1476.—The index of refraction of an oil is thought to be a good criterion of its commercial value. It has certain advantages over the specific-gravity method, in that it is less subject to modifying influences, such as for example the presence of foreign matter in suspension. Determinations can be made satisfactorily on much smaller quantities of oil than are usually needed for specific gravity work. Further, the method is shown to be of much value in identifying oils of similar provenance and in the correlation of oil-bearing horizons between different wells.

Means of determining the refractive index of petroleum by the Abbe Refractometer are described, and the relation between the refractive index and specific gravity of crudes and distillation fractions is discussed. Previous published data are used in this connection.

Available information on Venezuelan oils is given by means of graphs, and relationships between refractive index and A.P.I. gravity are shown. G. S. S.

240. Sand Filters for Oilfields. S. S. Taylor and L. F. Christianson. *Petrol. World (Lond.)*, 1937, **34**, 69–71.—This article is a summary of Report (R. 1.3334) by the above authors and issued by the U.S. Bureau of Mines. After discussing the con-

ditions in which sand filters can be used, and the analysis of brine for insoluble iron, hydrogen sulphide, carbonate stability, dissolved oxygen and determination of the hydrogen-ion concentration, the Report submits data, observations and conclusions from experiments in which a pressure sand-filter system and brine from a siliceous limestone formation were used. The experiments were made in connection with the study of a method for conditioning oilfield brines for injection into subsurface formations. Incidental to this study, it was necessary to modify certain chemical procedures to determine various components of the brine quantitatively. The report discusses the effect of filtration in a closed system on certain constituents of brine; presents comparisons of different filter sands, sand-bed depths, and filter-flow rates in connection with removal of suspended matter; and directs attention to factors that are essential in the construction and operation of a system that conditions brine by filtration. W. W.

241. Colorimetric Method of Determining Percentage of Oil in Cores. D. Hillis. *Bull. Amer. Ass. Petrol. Geol.*, 1937, **21**, 1477–1485.—This paper outlines a quick method of finding the percentage of oil by volume in oil-sand cores.

A fixed quantity of sand is introduced into a known amount of solvent. The colour imparted to the latter by the oil is then compared with the colours of five standard bottles containing known percentages of the oil in the solvent.

The method is valuable in a partly exhausted zone where it is required to distinguish between oil sands of varied saturation. A quantitative comparison is obtained of the percentage of oil in the cores after reaching the surface; this may be quite different from the oil content of the sand before coring.

The tests have been made from cores of wells drilled in the Santa Fe Springs and in the Olinda field. G. S. S.

242. British Oil Search. Anon. *Petrol. Times*, 12.2.38, **39** (996), 209–210.—The history, together with geological details, is given for the recently abandoned Kingsclere well. An unexpected thickness of 4033 ft. of Jurassic was met, but porosity was low and no extractable oil was found. The rig has been moved to Gun Hill near Macclesfield, where the next well will be drilled. R. O. Y.

243. United Kingdom Search for Oil. Anon. *Oil News*, 20.1.38, **43** (1312), 35–36.—This article is a summary of one given in the Oct.–Dec. *Bulletin of the Imperial Institute*. A *résumé* of the geological search and drilling operations by the various companies is given. R. O. Y.

244. Australian Oil Search. Anon. *Oil News*, 10.2.38, **43** (1315), 92.—None of the recent wells in Queensland have as yet reached finality. At Arcadia oil impregnation and non-inflammable gas shows have been met. At Hutton Creek a well has been commenced. At Kulmura, N.S.W., a well has met with shows in the Upper Marine Series at 5000 ft., and is to continue deeper. A well is expected to be drilled in Western Australia. R. O. Y.

245. Search for Oil in France and her Colonies. J. de Vries. *Rev. Petrolif.*, 31.12.37 (766), 1831–1839.—Since 1922 particular attention has been paid to indications of oil in France and her colonies. *Rhine Graben:* Present activity is the testing of a deep Trias productive zone. The previous history is described. *S.E. France:* Many shallow wells have been drilled without success, but further drilling in the Savoyan Juras is contemplated. *Languedoc:* At Gabian vestigial oil from that dissipated by volcanic activity was found, but bigger deposits may be found in less disturbed areas. *Aquitaine:* Indications associated with faulting have been unsuccessfully tested owing to lack of adequate cover. *Auvergne:* Structurally this region resembles the Rhine Graben, only volcanic influence has been present.

Morocco: The Pre-Riff region is composed of highly folded Mesozoic and Tertiary rocks, into which saliferous Trias has been intruded. A detailed study of stratigraphy and foraminifera and use of geophysics is necessary. Heavy rotary equip-

ment has only lately been introduced. Some success has been met with at Djebel Tselfat, and analagous structures are sought. At Rharb deeper drilling is necessary.

Tunisia : Here there are believed to be salt structures similar to those of Hanover. The drilling so far has been shallow, and deep search is necessary. New exploration wells have been started at Djebel, Zaouia and Rhazouane.

Madagascar : Oil-impregnated clays have been found in this island. In wells drilled so far traces of heavy oil have been met, and a further well is to be drilled.

French Equatorial Africa : In Middle Congo and Gaboun a great deal of exploration has been done and several shallow Calyx wells have been drilled, without reaching the oil horizon.

Cameroons : Geological surveys just completed have shown favourable conditions to exist here. Prospects also exist in Indo-China, Syria, New Caledonia and less favourable indications in the Antilles. R. O. Y.

246. Oilfields of the Permian Prikamye. N. Guerassimov. *Petroleum Excursion, XVII International Geological Congress, Moscow–Leningrad*, 1937, Fascicle 1, 5–16.—In 1929 oil was discovered at Verkhne-Chussovskiye Gorodki in Upper Uralian (Permian) limestones. These lie 243–391 m. deep, and are covered by Kungurian anhydrites, dolomites, clays and marls, which are arched over the limestones. Geological and geophysical work has revealed fifteen similar structures in this region.

The Krasnokamsk oilfield was found in 1934. Oil occurs in Lower Kungurian dolomites at a depth of 160–190 m.

The structures in the Kungurian beds of the Permian Prikamye seem to be due mainly to compaction of the beds on an irregular surface. Some believe the large calcareous masses, about which compaction has taken place, to be erosional forms, whilst others consider them to be reefs. G. D. H.

247. Oilfields of the Bashkirian A.S.S.R. A Blokhin. *Petroleum Excursion, XVII International Geological Congress, Moscow–Leningrad*, 1937, Fascicle 1, 17–32.—Prospecting during 1931 revealed the Ishimbaevo field 20 km. south-east of Sterlitamak. This field has three producing areas : on the western bank of the Belaya, on the eastern bank of the Belaya, and at Kusiankul, 4 km. north of the latter. These correspond to three "highs" on the oil-bearing Artinskian limestones. Two views are held of the origin of the limestone massifs of the Ishimbaevo field : that they are reefal or that they are erosional forms. In the overlying beds salt deposits are best developed in the areas between the limestone massifs, and at Smakaevo the salt has formed a diapir.

Oil shows occur in the alluvium, and in a number of wells the Ufimian and the Kungurian deposits have been found to be oil-bearing to some extent. They contain small accumulations of oil and gas. Commercial oil and gas accumulations are confined to the Lower Artinskian dolomitized limestones.

Oil shows have been found in Kungurian anhydrites and Artinskian limestones at Smakaevo. Showings have also been found in the lower parts of the Kungurian gypsum-anhydrite formation at Ryazanovka. G. D. H.

248. Oilfields of the Samarskaya Luka (Samara Bend). V. Boutrov. *Petroleum Excursion XVII International Geological Congress, Moscow–Leningrad*, 1937, Fascicle 1, 33–63.—Upper Carboniferous, Lower and Upper Permian, Jurassic, Cretaceous, Paleogene, Neogene and post-Tertiary beds outcrop in the Samara Bend region. In the western area asphalt is found in Upper Carboniferous and Permian rocks, frequently in accumulations of commercial importance. At Jiguli there are irregular patches of bitumen in the Middle Jurassic. The source of the bitumen is believed to be oil derived from the Middle and Lower Carboniferous. The Bakhilovo asphalt deposit is due to oil seeps connected with the formation of the Jiguli fault and flexure, the main structural feature of the region.

Towards the beginning of 1937 six wells had been completed at Syzran, ranging in depth from 656 to 1416 m. The deepest entered Devonian deposits. The others stopped in the Lower Carboniferous, which consists mainly of limestones with some dolomites, and veins and pockets of gypsum and anhydrite. The structure is not fully known, but the Palæozoic beds form a gentle uplift which is terminated in the

north-west by the Jiguli flexure. There appears to be a regular dome. Two main oil horizons are present.

4 km. beyond Otvajnoye village deep drilling is in progress, and two oil horizons corresponding to those of Syzran have been encountered. G. D. H.

249. Oilfields of the Azerbaijanian S.S.R. V. Hain, S. Apressov, and M. Mirtchink. *Petroleum Excursion, XVII International Geological Congress, Moscow–Leningrad*, 1937. Fascicle 2, 5–105.—The main producing areas lie on the Apsheron Peninsula, but prospecting is advancing westwards into Kabristan and the Kura plain. In 1936 Azerbaijan gave 72·5% of the total oil production of the U.S.S.R.

On the Apsheron Peninsula the general structural trend is north-west to south-east, but there are branching and ring-shaped folds. There are diapirs and crypto-diapirs. Several fields may lie on the successive elevations of a single fold. Mud volcanoes are frequent on the axes of the folds. Tertiary and Quaternary deposits cover the peninsula except for a few outcrops of Upper Cretaceous in the uplifts of the north-west. The Productive formation exceeds 1300 m. in thickness, and is subdivided on a lithological basis. This formation is variously supposed to have originated (1) as a delta or several deltas, (2) on land under a semi-desert hot climate, (3) as a deposit in an enclosed continental basin left by the Pontian sea. It occurs on the Apsheron Peninsula, in Kabristan and in the Kura river region, but the relationships of the various facies in time and space are unsettled.

The Shubany field lies on a steep-flanked fold. Early development was by pits. The old wells now give 70 tons of oil/day with 90–95% of water. On the south-west flank of the Lok Batan fold the Akchaghylian is absent, permitting the Apsheronian beds to rest on the Productive formation. On the crest the Productive formation is deeply eroded. The main production is from horizons IV, VI, VIa, VII, VIIa, and VIII, and in 1935 production was found beneath the overthrust on the north-west limb. Only the eastern part of the east to west Puta fold has been developed. The Productive formation is deeply eroded at Kergez-Kyzyl Tepe. The northern limb of the fold is steep and even overturned. In 1936 a well at Shongar was brought in with a flow of 2000 tons of oil/day.

The Bibi–Eibat fold is elongated north-west to south-east, with its flanks dipping at 12–33°. There are seventeen oil horizons and many faults. In 1924 development of the marine area was started. Exploitation at Sulu Tepe dates from 1933. The tectonics of Binagady are complicated. In places the Productive series is in contact with Kown and Maikop deposits. The main oil production is from the Kirmaku and sub-Kirmaku beds. At Balakhany–Sabunchy–Ramany oil horizons are distributed throughout the Productive series, but many of the upper ones are now water-flooded. There are many faults at Surakhany, where, in addition to oil in the Productive series, the Apsheronian and Akchaghylian beds have considerable oil and gas accumulations. Kala is on a gentle fold. The over-Kirmaku sandy beds are productive, as well as the Kirmaku and sub-Kirmaku beds. Gas occurs in the Apsheronian, Akchaghylian and Surakhany beds. Kara Chkhur is a dome, slightly elongated north to south. The distribution of the oil and gas is greatly affected by faulting. The Kirmaku and sub-Kirmaku beds are believed to have great possibilities. Zykh seems to be separated from Kara Chkhur by a fault, and a number of unsuccessful attempts preceded the discovery of oil there.

In Kabristan there are many surface-oil indications, but tests have been made on poor locations. The Kura plain has four lines of anticlinal uplift. The Pirsagat field lies on the most northerly fold. Oil is found in the first and second Pirsagat and the sub-Pirsagat horizons. The lower part of the Productive series has not yet been penetrated. The Nephte Chala fold is broken by several large faults. The Apsheronian beds gave a small oil output, but in 1936 a well entered the Productive formation and yielded 200 tons of oil/day.

On Artem Island the upper part of the Productive formation has been eroded, but the Middle Division, over-Kirmaku, Kirmaku and sub-Kirmaku beds are present. The island has produced 4·9 million tons of oil. G. D. H.

250. Oilfields of the Daghestan A.S.S.R. I. Brod and N. Uspenskaia. *Petroleum Excursion, XVII International Geological Congress, Moscow–Leningrad*, 1937, Fascicle 3, 5–37.—The zone of Tertiary deposits in the foothills of Daghestan is 30–50 km.

wide and 200 km. long. The folds are of late Miocene and early Pliocene age. Commercial oil accumulations are found mainly in sandy formations of Miocene age (Spaniodontella and Chokrak–Spirialis beds), but numerous oil indications are known in the Maikop beds (Oligocene–Lower Miocene) and Eocene beds (Foraminifera shales). Commercial gas resources are restricted to the lower part of the Maikop beds.

Within the Khosh Menzyl gasfield are gas seeps from Chokrak sandstones. At Dag Ogny gas seeps from fissures in the Ancient Caspian limestones. Even the largest flow of gas is under only a very low pressure. The wells are relatively shallow, and the gas accumulation in the domed Lower Maikop beds appears to be associated with a local thickening and increase in permeability of this horizon. Duzlak is a similar domal uplift on the eastern anticline of South Daghestan, which has not yet been exploited.

The early wells at Berekei were relatively small oil producers from the Khadum–Foraminifera contact. The wells also gave hot water saturated with iodides and bromides. The proportion of water produced increased. Oil was formerly obtained from pits at Kaia Kent, where the oil horizons are confined to the Middle Miocene Chokrak series. The field is broken up by faults connected with the main Kaia Kent overthrust.

Exploration at Izber Bash began in 1934, and in 1936 high-grade oil was discovered in the thick Chokrak sandstones. The field is on a dome on the eastern anticline of Southern Daghestan. An overthrust breaks the north-eastern flank. Drilling at Achi Su was started in 1930–31. This structure also lies on the eastern anticline of South Daghestan. Oil indications are confined to the lower part of the Chokrak beds, which does not outcrop. Commercial production was established in 1935 at depths of 300–700 m.

On the Chubar Arka elevation three wells drilled into the Lower Maikop beds have shown them to be highly saturated with oil. Numerous oil indications are confined to the dislocations of the Narat Tyube ridge. G. D. H.

251. Oilfields of the Chechenian-Ingushetian A.S.S.R. (The Grozny region). I. Brod, N. Elin, E. Starobinetz and V. Tiluipo. *Petroleum Excursion, XVII International Geological Congress, Moscow–Leningrad*, 1937, Fascicle **3**, 38–64.—During the period 1833–75 over 6,000,000 tons of oil were obtained from pits at Grozny. The first well at Old Grozny was drilled in 1893. In 1910 New Grozny was discovered. The Old and New Grozny fields are connected with the Sunja anticlinorium, whereas Malgobek, Gorska Mountain and Mujim Byru belong to the Tersky anticlinorium.

The New Grozny fold is elongated in a north-west to south-east direction. Its limbs are steep. Oil occurrences are confined to the Karagan and Chokrak beds, within which are twenty-two producing horizons, all in highly porous sandstones. The Apsheronian and Akchaghylian beds do not seem to partake of the full structure of the fold.

At Old Grozny Akchaghylian deposits ring the field and rest on various horizons of the Sarmatian. Oil is found only in the thick sandstones of the Karagan and Chokrak beds. There are twenty-two producing horizons, the upper ones of the Karagan series outcropping. Numerous large flowing wells have been drilled, some of which have given 1·5 million tons of oil. In 1932 an experimental adit was excavated to examine the possibility of mining oil. This adit revealed the great dislocation of the northern limb of the fold.

The Gorskaya Mountain oilfield is on the Kalauss anticline, which plunges westwards. An overthrust complicates the structure. The Chokrak beds are productive, and oil is expected in Karagan beds. The presence of a commercial oil accumulation below the thrust has been proved.

Drilling at Voznessenka began in 1901. At first there was little success, but before the Revolution the presence of a commercial accumulation of oil in the underthrust sandstones of the northern part of the fold had been proved. The Voznessenka field occupies the eastern part of the Malgobek oil region. There are nine producing horizons, 300–700 m. deep, in the Karagan and Chokrak sandstones.

Exploration at Malgobek began in 1927. In 1933 oil was discovered, and at the beginning of 1937 there were 160 producing wells. A thrust is present in the structure in addition to other dislocations. Oil is obtained from horizons in the lower part of the Karagan and the top of the Chokrak formation. G. D. H.

252. Oilfields of the Georgian S.S.R. N. Vassoyevich, K. Goguitidze, V. Pakhomov and K. Maslov. *Petroleum Excursion, XVII International Geological Congress, Moscow–Leningrad*, 1937, Fascicle **4**, 5–65.—The stratigraphy and main structural features of Georgia are described in considerable detail.

There are evidences of oil in Georgia in more than a hundred places. Oil was recovered primitively long ago. At Small Shiraki it has been produced from hand-dug wells since the days of the Persian occupation, and at Mirzaani oil was obtained from shallow pits in about 1870. Pits have also yielded oil in the Chatma–Baidy district. Between 1913 and 1926 wells were drilled at Mirzaani, Chatma, Eilar–Oughi and in the Aram–Dara district. Exploration at Ildokhani began in 1902. On the whole the work did not show marked success, due to faulty locations in some cases, and in 1929 comprehensive geological investigations were undertaken. 1936 saw marked advances.

Prospecting drilling is now concentrated on Mirzaani and Taribani. The former area involves beds from Sarmatian to Baku age, and had an output of 750 tons/month in 1936. It is a sharply bent, broken fold. Taribani is in the centre of a large anticline, 15 km. long. Its core is of Lower Shirakian beds, and on the limbs are Akchaghylian and Apsheronian beds. The objective is the lower part of the Upper Sarmatian. G. D. H.

253. Oilfields of the Kuban–Black Sea region. C. A. Prokopov, M. I. Varentzov, M. I. Maximov and G. N. Voronov. *Petroleum Excursion, XVII International Geological Congress, Moscow–Leningrad*, 1937, Fascicle **5**, 3–48.—In the north-west Caucasus there is a gradual change from the gentle monocline of the east to the steeper folding and even diapirs of the west, where the folds tend to be overturned to the south. The most important productive areas of the eastern part are on the monocline. North-west of Anapa and Gastogayevskaya the folds of the Caucasus plunge. Taman is the area where the Crimean and Caucasian trends meet at 120°.

In the eastern region (Maikop) oil occurs only in the Maikop beds, but in the west the distribution is wider. Due to the shallow-water nature of the deposits the oil occurrences are erratic, even where primary, and thus the Kuban region is characterized by lenticular and "channel" oil accumulations. Besides the Tertiary deposits, oil is also found in Mesozoic beds. The middle division of the Maikop series has shown commercial quantities of oil at Apsheron, Khadyji, Kutaiss, Asphalt Mountain and Kura Tyetye. It appears that a 30-km. zone west of Khadyji station offers good oil prospects.

At Asphalt Mountain Spongolitic sandstones outcrop and are covered by a large brea deposit. The beds dip at angles up to 57°, but are less steep at depth. The first indications of oil were found 190–260 m. deep, and a commercial accumulation was opened up in 1936. During last century oil was obtained from pits in the Spongolitic sandstones at Khadyji. After the Revolution a highly productive area was discovered in which the earlier wells flowed at the rate of 200 tons/day. In the Apsheron field the sands of horizons III and I wedge out before reaching the surface. The light oil horizon shows that a valley was eroded in the Foramanifera beds, and it was filled later with clays and sands. It is evident that the sands were deposited in the bed of a meandering river.

At Kudako, which lies on a fold with a diapiric core, oil horizons are found in clayey sandstones, sandy shell deposits and fissured marls, 200–500 m. deep. These belong to the second Mediterranean stage (Karagan and Chokrak). Keslerovo, where commercial oil was proved in 1936, is a diapiric fold with a core of Maikop beds. A good production of oil has been obtained from Meotic, Sarmatian and Maikop beds. At Adaghum oil horizons have been discovered in the Lower Sarmatian and Karagan beds.

Early work at Suvorovo–Cherkness gave evidences of oil in Pontian, Meotic, Karagan and Chokrak beds, but the production was erratic. On the Taman peninsula there are numerous mud volcanoes and oil indications. G. D. H.

Drilling.

254. Illinois Rotary Rig has Several Features. J. C. Albright. *Oil Wkly*, 20.12.37, **88** (2), 22.—Contractors in the new Illinois Basin area are using a coal-burning, steam-

saving rotary-drilling rig. This rig has several other points of interest, among which are the provisions made to facilitate moving and rigging up operations and the hook-up and method of running the two small steam engines that power all the equipment.

To facilitate moving and rigging up five items comprising the equipment are completely unitized, with all pipe fittings, safeguards and other fixtures so assembled that each unit makes one truck-load.

The boiler is of 100 h.p. capacity, and is fired with soft Illinois nut coal. For ease of cleaning the boiler is fitted with rocker-type grates. Draught is developed by having a common system of exhaust piping connected to the boiler smoke-box, which is equipped with petticoat piping. Exhaust pressure used for draughting the boiler is 4 lbs. per sq. inch. L. V. W. C.

255. Heavy Rotary Drilling Rig Used in Pechelbronn Oilfield. Anon. *Oil Gas J.*, 30.12.37, **36** (33), 85.—Petroleum in Pechelbronn is produced by wells and mining galleries. The mean density of wells in productive areas does not exceed 0·46 per acre, and the mean depth of the wells is 1213 ft.

Deep researches are in operation in Alsace, and the first well drilled with a rotary outfit was 4328 ft. deep in October 1937. The greatest depth for producing wells is 3083 ft., and as a whole the field has yielded about one ton per metre drilled.

Gas pressures are generally low, and wells are seldom completed as gushers. The flowing life of the wells is short, but the average life of the pump is about seven years. L. V. W. C.

256. Californian Operators Prepare to Drill to even Greater Depths. T. P. Sanders. *Oil Gas J.*, 13.1.38, **36** (35), 44.—To aid in the coming deep-drilling programme in the California area many improvements in equipment and methods are being developed. Most of these improvements have meant heavier, larger equipment, but in certain circumstances a change of design is required. This would occur in such cases as when the travelling block is too big, and there is insufficient room left in the derrick for stacking tall stands of drill pipe.

Steam generating plants have come in for considerable revision on account of the huge steam demand. Larger, higher-pressure boilers now meet the demand, and the change resulted largely from the use of insulation, superheaters, more efficient gas burners and feed-water preheaters.

A 14 × 14 in. horizontal engine twin drives the draw-works, whilst a 7 × 7 in. vertical twin drives the rotary table. A 7¾ × 20 in. duplex power pump is driven by a 12 × 12 in. vertical twin. L. V. W. C.

257. California Rig Spuds in with 11,300 ft. Sand Objective. T. P. Sanders. *Oil Gas J.*, 6.1.38, **36** (34), 43.—A test well has been spudded-in in the San Joaquin Valley, California, which has for its objective a known reservoir at a depth greater than 11,000 ft. This is the first time that such a project has been undertaken. A second well was spudded into the same reservoir a few days after the first well.

Drilling methods and equipment are of unusual interest. Only two strings of casing are called for, and with such a programme almost 10,000 ft. of open hole will be carried below the surface string before the water-string is run and cemented just above the oil sand.

The rig installed is the heaviest obtainable, and the 176-ft. derrick is mounted on 8-ft. steel substructure, which is in turn mounted on a concrete pad. The four boilers are 135-h.p. 350-lb. boilers with integral fired superheaters. Steam temperatures as high as 575° F. will be delivered.

A 1000-h.p. 14 × 14 horizontal twin roller bearing drilling engine is used for driving the 3-shaft, 3-speed draw-works, and double-chain drive is used on all sprockets.

The rotary table with under floor drive is built for 350 r.p.m., which is driven by a 9 × 8 horizontal twin engine.

Two 15½ × 8½ × 20 in. slush pumps are supplemented by a 14½ × 7½ × 18 in. pump which is used merely for mixing mud. L. V. W. C.

258. Welded Oil-Well Casing Joints. M. Cook. *Petrol. World* (*Lond.*), 1937, **34**, 9–14.—Paper presented to the A.P.I. pointing out the need for and the possibilities

of the development of welded couplings for casing, and also some of the problems to be encountered in that development.

The author concludes that from the single standpoint of tensile strength there is no urgent demand for the development of welded joints, but the demand is somewhat strengthened by the experience of leaking couplings in the deeper producing wells, and in view of the trend towards the use of flush-joint casing the outlook for welded joints is brightened. The strongest argument in favour of welded joints is the economic one, and unless some unforeseen difficulty appears, it is believed that the development of welded joints for casing is entirely possible. W. W.

259. Specifications for Oil Well Cement. I. R. J. Forbes. *Petrol. World* (*Lond.*), 1937, **34**, 218–220 and 237.—Paper, read before the Second Oil Congress in Paris, discussing the requirements of cement suitable for oil-well use. The author stresses that the testing methods should be adapted to the conditions under which the cement is placed in the oil well and that the following points must be taken into account :—

(1) Always examine test pieces made from slurries of neat cement.
(2) Examine test pieces made in different water-cement ratios.
(3) Test pieces should be examined at different temperatures.

On the subject of oil-well cement specifications there is still a lot of work to be done, not only research work, but also, and even more particularly, standardization of testing methods and requirements. The author expresses the hope that the petroleum industry will give their opinion as to what requirements they think such an important auxiliary material as oil-well cement is to meet. W. W.

260. Hardening of Mud Sheaths and Suggested Method for Minimizing their Sealing Effects in Oil Wells. C. P. Bowie. *Oil Wkly*, 3.1.38, **88** (4), 32.—Laboratory experiments can scarcely be expected to reproduce under-ground oil-well conditions, but there is no doubt that drilling mud will solidify when in quiescent contact with crude oil. The time required for such solidification to take place and the degree of hardness obtained will depend on the amount of moisture present and the amount and type of oil contacted.

It is suggested that many low-pressure oil- and gas-bearing formations have been drilled through without being detected. The solidifying of the sheath has securely sealed the formations. It has also been suggested that many prolific oil sands are yielding only a small part of oil, for the same reason.

It appears desirable that more careful testing of each formation as drilling proceeds, and the use of a mud fluid properly processed to permit more of the oil and gas encountered to flow freely into the well, are necessary.

If a proper amount of treated material is used, the mud sheath should be permeable to oil, and the cost of processing the mud fluid should not be excessive.

L. V. W. C.

261. Use of Screened Liners in Lagunillas Field, Venezuela. H. H. Plummer. *Oil Gas J.*, 30.12.37, **36** (33), 113.—As a means of preventing sand incursion into the well bores of the Lagunillas Field, Venezuela, 6⅝-in. perforated pipe was used. The size of the opening proved too large, and after considerable experimentation 6⅝ pipe perforated with 432–¼-in. holes per foot was adopted. This, however, proved inadequate, and attention was turned to screen pipe. The final adoption, after successful operation had demonstrated its utility, was 25- and 30-mesh screen either perforated with 180–½-inch holes per foot or slotted with 30–⅜-in. × 3 in. openings per foot.

An investigation of the failure of perforated liners permitted the following conclusions to be reached.

Stresses caused by deviations up to 10 in. may be neglected. Failure resulting from the load of the drill pipe being imposed upon the liner during setting operations can be neglected, as the liner would be supported throughout its length by the walls. The sealing of the tubing string to the top of the liner may be regarded as a possible cause of failure. The most important cause of a liner failure was considered as due to the beam action, especially when acting in conjunction with vertical stresses.

The author gives a number of subjects for future investigation. L. V. W. C.

262. Multiple Wells. E. S. Post. *Oil Wkly*, 17.1.38, **88** (6) 50.—In many of the multiple sand oilfields, especially along the Gulf Coast trend, multiple wells are a new development.

The operation is not hazardous from a profit recovery standpoint where multiple completions are at a shallow depth. In the deeper areas, however, the situation takes on a different aspect. The cost of drilling versus desire for immediate recovery, required offsetting, or production economy, are principally the alternative answers for multiple drilling.

The mechanical aspects of the twin development are interesting. Definite information must be obtained before the drilling of these multiple tests to determine their producing possibilities. The favourite method is to locate a key well in which the entire section is carefully cored and each sand given drill stem tests. The base sand of the multiple group is then produced in the initial test. A second location is then projected to one of the other sands from 25 to 80 ft. away. Third and fourth wells are drilled on the same master location. L. V. W. C.

263. Drilling Patents. A. C. Catland. U.S.P. 2,100,311, 30.11.37. Core drill.

A. G. Welikanov. U.S.P. 2,100,418, 30.11.37. Universal joint type orienting device for borehole deflecting tools.

J. C. Wright. U.S.P. 2,100,419 and 2,100,420, 30.11.37. A drill collar for well drilling strings having a passage for conducting the circulation fluid and means for receiving flushing fluid from a wash-over pipe.

H. G. Campbell. U.S.P. 2,100,586, 30.11.37. Well-cementing device consisting of a barrel provided with discharge ports at its lower end, a valve in the barrel normally closing the ports and spring means for removing the valve from the ports.

W. A. Abegg. U.S.P. 2,100,621, 30.11.37. A well reamer.

P. C. Efromson. U.S.P. 2,100,640, 30.11.37. Cutter assembly for well drills.

M. W. Corrall. U.S.P. 2,100,684, 30.11.37. A well-bridging, cementing, whipstock and milling apparatus comprising a cylindrical housing having an inclined whipstock placed inside and fluid means of moving this whipstock and to set a packer which is housed in the head of the whipstock.

C. J. Maber. U.S.P. 2,101,007, 30.11.37. Well reamer.

D. B. Monroe. U.S.P. 2,101,185, 7.12.37. Whipstock for deviating wells.

W. C. Chonette and R. H. Hamilton. U.S.P. 2,101,640, 7.12.37. Method and apparatus for cementing wells.

L. V. Mallony. U.S.P. 2,101,815, 7.12.37. Slip socket.

H. P. Wickersham. U.S.P. 2,101,968, 14.12.37. Rotary drilling jar.

W. Brauer. U.S.P. 2,102,055, 14.12.37. A side-tracking tool comprising an anchor to be set in the well, a tapered mandrel, carried by the anchor, an eccentric bushing slideable on the mandrel and a milling cutter carried by the bushing.

F. J. Hinderliter. U.S.P. 2,102,072, 14.12.37. Rotary tool joint.

M. M. Kinley. U.S.P. 2,102,080, 14.12.37. A surveying device for recording surface irregularities of a bore hole by means of feelers which record variations of the surface.

J. G. Dyer. U.S.P. 2,102,555, 14.12.37. A method of drilling wells through caving formations by means of a drilling mud containing a silicate and maintaining continuous circulation even when adding to the drilling string.

B. L. Shannon. U.S.P. 2,102,754, 21.12.37. Drilling jars.

J. Basgan. U.S.P. 2,103,137, 21.12.37. A rotatory well drilling apparatus in which two pumps are used : one to supply the circulating fluid, and the other to produce

pressure variations in the liquid column within the supply conduit and the drill string so as to set up longitudinal vibrations in the liquid column and drill string.
L. V. W. C.

Production.

264. Obtaining Maximum Production through Efficient Operation of Subsurface Pumping Equipment. Part I. D. E. Schrobrich. *Oil Wkly*, 10.1.38, **88** (5), 22.—The presence of such subterranean hazards as acid, corrosion, gypsum, abrasion, sand, paraffin, etc., results in less than maximum production. In addition, the operator confronted by these hazards finds that many of his problems centre about the efficient and successful operation of the subsurface pumping and fluid lifting equipment.

Rapid strides have recently been made in successfully combating these subterranean conditions, and many of the major difficulties have been satisfactorily brought under control.

The manner in which the various hazards hamper production are stated, the methods taken to remedy the situation and the results obtained are discussed.

In this article, sulphide, and corrosive conditions, sand and abrasive conditions are considered.
L. V. W. C.

265. Efficient Operation of Subsurface Pumping Equipment. Part II. D. E. Schrobrich. *Oil Wkly*, 17.1.38, **88** (6), 22.—This article deals with the clearances of the pump parts and the destructive effects of misadjustments, together with the losses in efficiency brought about by lack of proper adjustment. Insert and plunger type pumps are considered from the slippage point of view.
L. V. W. C.

266. Diesel and Gas Individual Well Pumping Units, etc. Anon. *Petrol. World (Lond.)*, 1937, **34**, 1–4.—New plans of mechanizing individual well units for good operation introduce greater opportunities for all types of internal-combustion engines. The types of engines which have been and are being used are discussed and the following conclusions are reached :—

(1) High-speed oil and gas engines are becoming more and more applicable for individual well-pumping units.

(2) Single-purpose pumping units offer the best opportunity to secure lowest power cost.

(3) Engines of either high or low speed have to be of the highest order in design and workmanship to withstand field usage for pumping.
W. W.

267. Artificial Lifting in Rhodessa Field Prevents Various Problems. J. Weber. *Oil Gas J.*, 6.1.38, **36** (34), 30.—More than 10% of the wells on the Rhodessa Field are producing under artificial lift, but it is important to note that in most instances these wells represent special cases. They are the tests drilled in the marginal production areas or the improperly completed wells, and do not represent the average wells of the field. The field is normally a flowing one, and the general trend towards pumping and gas lifting is not expected for some time to come.

Flank encroachment of water in this faulted anticlinal structure is an important influence in hastening the time when pumping or gas lift is necessary.

Lower fluid levels accompany reduced pressures in the tight rock areas, and result in an increasing number of wells incapable of making their daily allowables. This inability to make the daily allowable production has prompted the use of the gas lift, but it is generally agreed that the ultimate conversion to artificial lift will be to pumping. Water drive is probable when gas in oil solution decreases to a point where it will not force the oil to the wells.

Reconditioning of the improperly completed wells has resulted in the allowables being raised through the reduction in gas–oil ratios.
L. V. W. C.

268. Subsurface Disposal of Oilfield Brines in South Louisiana. D. E. Fuelbhart. *Oil Gas J.*, 6.1.38, **36** (34), 46.—The disposal of the salt water produced with the oil in the South Louisiana fields is a serious problem because of the pollution involved.

In many cases the salt water is stored in earthen pits or reservoirs in or near the oilfields, to be turned loose to the natural drainage in the winter months when the rainfall is sufficient to cause dilution to such an extent that the pollution is greatly lessened.

In South Louisiana the practice of disposing of the brines by pumping them into subsurface reservoirs through a well was first inaugurated in the Lake Barre Field in 1933. Since then the practice has been adopted in many fields, and it appears at present that this method of disposal of oilfield brines is very practical in the Gulf Coast area of South Louisiana. L. V. W. C.

269. Acid Treatment of Oil Sands in South Texas. F. B. Plummer. *Oil Wkly*, 3.1.38, **88** (4), 24.—The exact details of the action of an acid on an oil-and-water-bearing formation is not fully known, but laboratory studies on limestones throw some light on the process.

The main effect of the acid treatment is to enlarge the hole and to produce a shallow depression at points of greatest permeability.

The amount of enlargement can be calculated by knowing the amount and strength of the HCl used and the density of the limestone in the hole.

The method of introducing the acid into the oil-producing zone must be carefully considered, so that in wells making water there shall be no increase of the water.

It is clear that each is a problem in itself, and the fullest co-operation between the geologist, who knows the formations, the engineer, who knows the physical chemistry of reservoirs and reservoir waters, and the practical, experienced operator, who can carry out, skilfully, methods suggested, is absolutely necessary. L. V. W. C.

270. Induced Draught through Gas Vent Reduces Fire Hazard. F. B. Taylor. *Oil Wkly*, 20.12.37, **88** (2), 17.—To reduce to a minimum the dangers of ignition of gas naturally produced during the servicing of wells in the Mansion area of the Oklahoma City field special installations have been made to induce a draught from the danger zone. The velocity of the gas coming away during tubing and rod jobs is considerably increased. This causes a reduction of the pressure in the separator, and through it pulls a partial vacuum on the casing. The vent line is a riser some distance from the well freeing the gas at a height well above any surface ignition danger.

L. V. W. C.

271. Problem of Idle Wells. I. Ganitzki. *Monit. Petr. roum.*, 1938, **39**, 35–36.—At present, with very few exceptions, only wells with a daily output of 1 metric tonne or more are being exploited.

A table shows the number of wells in the Azerbaidjan field arranged according to daily output. Out of 4557 wells functioning in March 1936, 30% of the total output came from 92 wells.

On July 1st, 1936, there were 4539 wells working, 236 being repaired, and 2428 suspended or idle. Tables showing the distribution of these among the various trusts are given.

The total output of the wells shut down in Azerbaidjan is about 4 million tonnes per year.

After a visit to America and a conference in Moscow, it was decided to reopen the wells shut down on account of low output. The programme envisaged a reopening of all wells by the end of 1937, but this has been extended to the end of 1938.

American installations are being used, especially slow-speed pumps. These low-output wells can only be worked economically by reduced staffs with simplified apparatus, light portable motors, and the grouping of wells for pumping or gas-lift. In the U.S.A. wells with an output of 0·1 tonne or more per day can be economically worked by these methods, while until recently 1 tonne per day was considered as the low limit in Baku and 0·5 tonne in Starogrozni.

Experiments with 24 wells have given satisfactory results. Slow-speed pumps working at 2 to 5·5 revolutions per minute (according to the flow of each well) have increasqd the total output by 100%. With the appointment of L. M. Kaganovitch to the head of the Oil Industry in August 1937, a speeding up of the exploitation of low-output wells began. W. E. J. B.

272. **Treating Emulsions.** H. J. Cavigli. *Oil Wkly*, 3.1.38, **88** (4), 17.—The author presents a method for determining what amount of chemical is required to break down an emulsion in any given crude and a method for inserting or injecting the chemical into the crude flow line. L. V. W. C.

273. **Patents on Production.** M. M. Kinley. U.S.P. 2,100,807, 30.11.37. Apparatus for cleaning well screens using an explosive to work a piston to discharge fluid through the inlets.

G. D. Every. U.S.P. 2,101,537, 7.12.37. Fabricated well screen. L. V. W. C.

Transport and Storage.

274. **Improvements in Gas Transmission and Compression of Natural Gas.** A. L. Forbes, Jr. *Oil News*, 1937, **41**, 240–241.—Paper prepared with the idea of relating some of the experiences encountered in operating a certain high-pressure natural gas transmission pipe-line system consisting of a total of 715 miles of main lines, composed of 218 miles 16-in., 224 miles 12¾-in., 233 miles 10¾-in., 40 miles 8⅝-in., and 53 miles of 6⅝-in. and 4½-in. branch lines. The maximum working pressures of the various lines are as follows: 16-in. 450 lb.; 13⅜ and 10¾-in. 650 lb.; 8⅝, 6⅝ and 4½-in. 500 lb., all per square inch.

The sour gas required installation of two purification or treating plants, and numerous sand storms in the area made it necessary to provide dustproof hoods over machinery parts such as compressor-engine piston rods. W. W.

275. **Field Application of Pipe-Line Coatings.** J. C. Stirling. *Petrol. Engr*, Jan. 1938, **9** (4), 71.—Numerous investigations have been made of the corrosion resistance of various types of pipe-line coatings, but insufficient attention is frequently paid to the preparation of pipe, the method of applying the coating and to the handling of the pipe after application. A description is given of mechanical methods of cleaning, priming, coating and wrapping pipe-lines. The improved pipe-cleaner described is driven by an 85-h.p. motor mounted overhead equipped with a double cleaning-head carrying wire brushes, cutter heads and scraper knives which can be used in any combinations. With the machine described four men can clean two miles of pipe per day at less than half the cost of hand-cleaning and with greater efficiency. Priming the pipe at the mill is recommended if unfavourable weather conditions during laying are expected, or if the pipe is likely to be exposed to the elements for a long period of time. A thin primer should be used, as a thick material tends to collect foreign matter. A priming machine for field applications may be attached to the back of the cleaning machine, two men only being required to do the work of six or eight men when using the belt method. Considerable time is saved, as by the older method the pipe had to be allowed to become sufficiently dry to handle before moving the skids to allow the areas covered by them to be primed. A 30% saving in paint and a more uniform coating are obtained. Immediate priming after cleaning is desirable, as it prevents frost and mud, etc., collecting on the pipe. The coating tests under the supervision of the National Bureau of Standards proved that the protective value of bituminous coatings increased with their thickness, and that shields or reinforcements, preferably asbestos, added materially to the effectiveness of the bitumen. The coating standardized on in the present case consisted of a $\frac{3}{32}$ in. thickness of asphalt, followed by a bonded wrapping of asbestos felt and an outer coat $\frac{1}{16}$ in. asphalt. No advantage is considered to be given by the use of fillers in the bitumen or by enamels. The possibility of omitting the final coat and increasing the thickness of the first coat is being considered from the point of view of economy and of decreasing the action of soil stress, which is less in the case of felt than of bitumen. A machine for wrapping the felt is described, this being revolved manually around the pipe. Similarly, a coating machine has the advantage of providing a more uniform coating free from imperfections with less bitumen at a greater speed. The ditch should be cleaned of all rocks, skids, clods, etc., and padded with 4–6 in. of loose soil, the pipe being lowered with non-abrasive canvas slings, preferably during the coldest part of the day. The pipe is covered with 6 in. of loose soil, and

care taken to remove skids and other refuse from the dirt used for backfilling. Pipe protected and laid by the above methods remained in good condition for 13 years in the alkali flats of Nebraska, whereas adjacent unwrapped pipe was almost beyond recovery. C. L. G.

Gas.

276. Propane, Butane and Related Fuels. U.S. Bureau of Standards. Letter Circular No. 503 (Supersedes LC. 292), September 1st, 1937.—A description is given of the composition, manufacture, properties and methods of distribution of commercial propane and butane. Particular attention is paid to the domestic and industrial utilization of these fuels, from the point of view of methods of delivery, storage and of burner equipment. A list is given of the leading distributors of liquefied gases, with trade names and composition of product.

Reference is made to the disadvantage of the use of butane and propane in cold climates owing to insufficient vaporization. The variable nature of the vapours from mixed fuel gases restricts their use for domestic purposes, though they are suitable for town-gas enriching. A satisfactory method of use is to draw off the liquid from the bottom of the container and heat in a special vaporizer. For small-town gas supply the greater ease of vaporization of propane over butane outweighs the greater cost, but for larger systems butane is preferred. In order to prevent condensation, butane is supplied mixed with air, the resulting mixture having a heating value frequently as low as 520 B.Th.Us. per cu. ft., and involving the use of special burners. Underground storage presents many problems, corrosion being the most serious. It is recommended that no gases lighter than pentane be stored underground.

The relative costs of different fuels per million B.Th.Us. are given as :—

Propane	$4.61
600 B.Th.U. Washington gas . . .	$1.50
Kerosine	78 cents.
Electricity	$8.57

Propane is probably 10% more efficient than town gas for cooking purposes. The effect of impurities in propane is discussed from the point of view of the varying composition of the vapours from propane and butane and propane and ethane with full and half-empty cylinders. C. L. G.

277. Patents on Gas. T. Nagel. E.P. 476,275, 6.12.37. Production of fixed hydrocarbon gases from oil.

Koppers Co. E.P. 476,332, 6.12.37. Treatment of fuel gases to prevent gum formation during distribution in distribution systems by subjecting them to high potential electric discharges, *e.g.* "brush" or "point" discharge.

Gas Light and Coke Co. R. H. Griffith and B. Crawley. E.P. 476,684, 13.12.37. Removal of nitrogen oxides from coal gases by passing them at temperatures above 100° C. over a catalyst prepared by reducing the oxide, hydroxide or carbonate of cobalt or nickel by heating in the presence of a reducing gas at 300–550° C.

A. R. J. Ramsay. E.P. 476,879, 15.12.37. Improved apparatus for the continuous production of water gas from brown coal, etc. W. S. E. C.

Fire Prevention.

278. Foam Extinguishment Dwarfs Other Methods on Oil Fires. M. G. Van Voorhis. *Nat. Petrol. News*, 10.3.37, **29** (10), 66.—Two general foam systems are in use : the two-solution system and the dry-powder system. Each has its advantages and disadvantages, and opinion is divided as to which is the best method of handling. This article discusses in some detail the arguments for each type and the reasons for and against different methods of mixing foam ; some advocate mixing the foam immediately prior to its reaching the fire zone ; others prefer to pass the mixed foam for some distance through pipes before reaching the fire. W. W.

Hydrogenation.

279. **Coal Oils in France. Developments in Hydrogenation Technique.** Anon. *Chem. Tr. J.*, 11.2.38, **102**, 109.—At a recent meeting of the Société des Ingenieurs Civil de France, papers were presented on the development of the coal-oil industry in France (published in January 1938 issue of *l'Industrie Chimique*). The coal hydrogenation plant at the works of the Société des Carburants Synthétiques des Mines de Béthune produced in the first year of operation 3,240,000 litres of petrol from 7626 tons of coal. The hydrogenation stage utilizes, instead of large vessels, numbers of small tubes grouped into bundles and heated by coal gas. No difficulties are caused by this method, there is no cokefaction of the coal and prolonged continuous operation is possible. Lignite is more readily hydrogenated than bituminous coal. For the second stage, hydrogenation in the vapour phase, a bigger concentration of hydrogen is used than in the first stage. The spirit obtained had an octane rating of 76·5. The hydrogenation plant at Liévin uses the Audibert process, and has a capacity of 48 tons of coal per day. Hydrogenation in the liquid phase is effected at a pressure of 300 kg., the coal being finely ground and pasted with oil. The paste is preheated to 300–380° C. with naked fire, this stage being difficult to control. Three autoclaves are used in series for the first stage, and one for the vapour phase hydrogenation, operating at 450–500° C. Heat recovery has been studied, a 60% recovery being attained. The unreacted hydrogen is recovered from the waste gases by cooling to below zero under a pressure of 300 atmospheres. A Fischer–Tropsch plant developed by the Société Courrières-Kuhlmann, which came into operation last June, is at present operating at a capacity below its planned output of 20,000 tons petrol per year.

C. L. G.

280. **Hydrogenation of Roumanian Petroleum.** C. Candea and A. Marschall. *Monit. Petr. roum.*, 1937, **38**, 1879–1884.—A brief historical survey of the more noteworthy work on cracking and hydrogenation is followed by an account of a series of experiments on Roumanian petroleum.

The authors have used a Moreni crude, the density and distillation characteristics of which they record. 170·5 gm. of oil are mixed with 20 gm. of a catalyst composed of 13·4 gm. MoS_3, 3·4 gm. MgO and 2·6 gm. Al_2O_3. The oil is hydrogenated at 300–350° C. in a 1·9-litre steel autoclave with an initial hydrogen pressure of 25–150 atm., rising during reaction to a maximum pressure of about 300 atm. The composition of the resultant oil under various pressures and temperatures is given and the changes in pressure during the reactions are recorded. Data are given for similar experiments upon benzine, kerosine, fuel oil and lubricating oils. In the latter case viscosities, flash points, and acidities are recorded.

The authors conclude that—

(1) Hydrogenation cracking is a function of the pressure and temperature, as well as the chemical constitution, apparatus and catalyst.

(2) In the case of their particular apparatus, and with the MoS_3 base catalyst, the most favourable conditions were 200–300 atm. pressure and 300–350° C.

(3) The maximum yield of spirit was about 50%.

(4) The lower fractions are more easily hydrogenated than the higher.

(5) As the pressure increases the coke diminishes eventually to vanishing point. The sulphur also diminishes with increase of pressure.

(6) The hydrogenated spirit is stable, and has only a trace of sulphur.

T. C. G. T.

281. **Patent on Hydrogenation.** H. E. Potts. E.P. 476,744. Regulation of temperature in the hydrogenation of distillable carbonaceous substances by intermittently reintroducing into the catchpot by means of an injector operating with the hydrogenation gases—a portion of the heavy liquid products from the catchpot.

W. S. E. C.

Polymerization.

282. **Patents on Polymerization.** Universal Oil Products Co. E.P. 477,128, 22.12.37. Mixed polymerization of isobutene and propene at 93–103° C. and under 34–41 atm.

pressure to produce isoheptenes. The polymerization is carried out in the presence of steam, and the catalyst used is a precalcined mixture of phosphoric acid and a siliceous adsorbent.

V. N. Ipatieff and R. E. Schaad. U.S.P. 2,101,857, 14.12.37, and U.S.P. 2,102,073–2,102,074, 14.12.37. Polymerization of unsaturated hydrocarbons in two stages using solid phosphoric acid as catalyst. W. S. E. C.

Chemistry and Physics of Petroleum.

283. Influence of Acetone on the Water Tolerance of Benzine/Alcohol Mixtures. E. Affeoni. *Olii Min.*, 1937, **17**, 85–86.—The water tolerance of mixtures of benzine and ethyl-, isopropyl-, or isobutyl-alcohols is greater than that of mixtures of benzine and acetone, *e.g.*, the water tolerance of a 75/25 mixture of benzine and alcohol is 22·2 c.c. per litre, compared with 2·6 c.c. per litre for a corresponding mixture of benzine and acetone. The water tolerance of benzine and *cyclo*hexane with mixtures of acetone and alcohols is greater than with acetone and alcohol alone. In the case of benzine, the addition of acetone increases the water tolerance, but to a smaller extent than the addition of a similar quantity of alcohol. C. C.

284. Side Reactions Occurring in Wurtz Syntheses. A. A. Morton and F. Fallwell. *J. Amer. chem. Soc.*, 1937, **59**, 2387–2390.—The interruption of a Wurtz synthesis at the mono- and di-sodium intermediate stage has been utilized to show that when methyl iodide is added to amyl sodium, the amyl radical dimerizes to decane rather than combining to form hexane.

If iodine is added rapidly to a solution of phenol sodium, iodobenzene is chiefly formed; if added slowly, biphenyl results. W. E. J. B.

285. Some Derivatives of Certain Higher Mercaptans. D. Fore and R. W. Bost. *J. Amer. chem. Soc.*, 1937, **59**, 2557–2558.—This paper describes the preparation and properties of a number of new disulphides, lead mercaptides, and the corresponding 2 : 4-dinitrophenyl thioethers and dinitrophenylalkyl sulphones.

The starting point for the synthesis in each particular series was the appropriate alcohol.

The paper gives the melting points of the mercaptides, thioethers, sulphones and disulphides concerned, which are from dodecyl up to nonadecyl, with the exception of pentadecyl. W. E. J. B.

286. Fluorinated Derivatives of Propane. A. L. Henne and M. W. Renoll. *J. Amer. chem. Soc.*, 1937, **59**, 2434–2436.—This paper describes twelve fluorinated derivatives of propane which have been prepared. The physical properties of these derivatives are given.

As an example, 2 : 2-dichloropropane is treated at 0° C. with excess antimony trifluoride, containing 5% bromine by weight. The reaction occurs promptly, and is regulated by means of an ice bath intermittently applied. At the end of the reaction the temperature is raised to 70° C. and about 85% of 2 : 2-difluoropropane is obtained, and 10–15% of 2-chloro-2-fluoropropane.

In general, the results show the stability and stabilizing effect of a CF_2 group, and the facility with which an isolated CF_2 group can be produced. A compound containing such a group is physiologically inert.

The general effect of a fluorinated group on chlorination or on further fluorination is described. W. E. J. B.

287. Nitrogen Compounds from Petroleum Distillates. X. Purification of Nitrogen Bases with Zinc Chloride. R. I. Mahan and J. R. Bailey. *J. Amer. chem. Soc.*, 1937, **59**, 2449–2450.—This paper describes a method whereby a double salt of the base with zinc chloride is formed, which at elevated temperatures is dissociated with the liberation of the free base.

Where zinc chloride salts of the type $(Base\ HCl)_2ZnCl_2$ are involved, the dissociation

occurs into base, hydrochloric acid and zinc chloride, with the base and acid recombining as a sublimate of base hydrochloride.

In this case it is necessary to add sodium hydroxide sufficient to neutralize the hydrochloric acid in combination with the nitrogen base, and to precipitate a small amount of zinc hydroxide as a convenient indicator for the endpoint of the reaction involved in acid neutralization.

The process includes the removal in one operation of water, hydrocarbons, thio and phenolic bodies, and other associated non-basic admixtures. W. E. J. B.

288. Dehydrogenation of Hydroaromatic Hydrocarbons with an Alkyl Disulphide. J. J. Ritter and E. D. Sharpe. *J. Amer. chem. Soc.*, 1937, **59**, 2351–2352.—This paper describes the dehydrogenation of tetralin to naphthalene, and of ionene (1 : 1 : 6-trimethyltetralin) to 1 : 6-dimethylnaphthalene by means of isoamyl disulphide.

The action of the disulphide on tetralin proceeds as follows: $C_{10}H_{12} + 2R\text{-}S\text{-}S\text{-}R \rightarrow C_{10}H_8 + 4RSH$. The yield of tetralin was 70% and that of 1 : 6-dimethylnaphthalene, 32%.

It was found that the methyl group from ionene is eliminated mainly as methane in this disulphide dehydrogenation, and accordingly the normal sulphur dehydrogenation method was applied to ionene, and a similar result obtained.

W. E. J. B.

289. Isolation of Pure Isomeric Hexanes from Natural Gas. J. H. Bruun, M. M. H. Bruun and W. B. M. Faulconer. *J. Amer. chem. Soc.*, 1937, **59**, 2355–2360.—The authors have isolated three of the isomeric hexanes from a commercial cut taken from natural gas originating from the Clendenin gas-field, W. Virginia.

The isolation was accomplished by distillation (100 Plate Still), and the physical constants of the isomers were determined as follows:—

Boiling Point at 760 mm. °C.	F. pt. (in vacuo) °C.	d_4^{20}	n_D^{20}
2 : 3-dimethylbutane. 57·93 ± 0·05	− 129·0 ± 0·5	0·6615	1·3750
2-methylpentane. 60·19 ± 0·05	− 154·0 ± 0·05	0·6527	1·3711
3-methylpentane. 63·20 ± 0·05	—	0·6640	1·3764

It will be noted that the freezing point of 2 : 3-dimethylbutane is 6° higher than the accepted value for this hydrocarbon, whilst the freezing point for 2-methylpentane is 11° lower than the previously reported value.

The phase equilibrium diagram for the condensed system 2-methylpentane-*n*-heptane has been determined and the observed value for the eutectic point was − 160·2 ± 0·5° C. W. E. J. B.

290. Identification of some Aliphatic Sulphonic Acids. P. H. Latimer and R. W. Bost. *J. Amer. chem. Soc.*, 1937, **59**, 2500–2501.—The authors have found that phenylhydrazine makes an ideal reagent for the identification of aliphatic sulphonic acids. Stable salts are formed which may be purified easily. The melting points of the salts are sharp and well defined, and the derivative is of such a nature that a molecular weight may be run by titration with standard alkali, thus serving as a double check on the identity of the acid under investigation.

The paper contains the melting points of the phenylhydrazine derivatives of the aliphatic sulphonic acids from methyl to *n*-octyl.

Mixed melting points on the acids were run, and where the two acids differed by one methylene group, the depression in the melting point was about 3° C.; where the acids differed by two methylene groups, the depression was about 15° C.

W. E. J. B.

291. Alkylation with a Hydrogenating Catalyst. V. I. Komarewsky. *J. Amer. chem. Soc.*, 1937, **59**, 2715–2716.—This article describes a direct alkylation of benzene and *cyclo*hexane with ethylene in the presence of a specially prepared nickel alumina catalyst.

The ethylene and the benzene were passed over the catalyst at 350° C., and from the liquid product, which was completely free from unsaturated hydrocarbons, toluene was isolated and identified.

A similar experiment with ethylene and *cyclo*hexane at a temperature of 300° C. produced a liquid product free from unsaturateds which also contained toluene.

It is concluded that the benzene and ethylene formed ethylbenzene which decomposed to toluene and methane, and that in the case of *cyclo*hexane this was decomposed to benzene, which was then alkylated as described above. W. E. J. B.

292. Refractive Indices at Low Temperatures. A. V. Grosse. *J. Amer. chem. Soc.*, 1937, **59**, 2739–2741.—This paper describes how the Abbe Refractometer can be used for low-temperature measurements, the lowest used so far being — 50° C.

The paper is illustrated with data obtained at — 25° C., showing the difference in refractometer readings for mixtures of *iso*butane and *n*-butane, *iso*butane and *iso*butylene, average *n*-butenes and 1 : 3-butadiene.

Additional data are provided on various other compounds at low temperatures, and it is stated that the refractive index of ethyl fluoride at —40° C. is the lowest yet recorded for any liquid or solid compound. Actually, for the sodium D line the refractive index at this temperature, for this compound, is 1·3057. W. E. J. B.

Analysis and Testing.

293. Colour of Oils and Petroleum-Resins Content. R. Kostechau. *Z. Ver. dtsch. Chem. Beiheft*, 1937, No. 28, 34–39.—The degree of refining or of ageing of an oil can be expressed as an Extinction Quotient k^1/k, k being the value of an extinction coefficient for the new oil and k^1 the value for the aged or the refined oil.

The extinction coefficient is the percentage of blue light (for maximum absorption) transmitted by unit thickness of oil layer.

This method shows up the fallacy of judging oils by their colour, since the relationship between light colour and degree of refining is very limited. The double logarithm of the extinction coefficient gives an absolute or "typical" colour (*i.e.*, "tint") curve. In good refining or in a well-refined oil, the log K curve is very steep. The increase in slope with progressive earth treatment illustrates this. Similarly the tangent of the "typical colour (tint) curve," obtained by dividing the difference in log K values for different wave-lengths of light by the wave-length difference, gives angles of slope varying with the purity of the product. The method is considered useful in analysis of used oils and in assessing the bleaching power of earths.

J. L. T.

294. Development of Acidity in Certain Lubricating Oils on Use or Oxidation. A. R. Rescorla, F. L. Carnahan and M. R. Fenske. *Industr. Engng Chem. Anal.*, 1937, **9** (12), 574.—Four lubricating oils (100 V.I.) were used under controlled conditions in four Dodge 6-cylinder motors, and samples were drawn periodically from the oil circulation line. These samples were tested for neutralization number, viscosity at 100° F., sludge formation, carbon residue and iron content. Graphical representation of the latter four inspection characteristics against the neutralization number showed that definite relationships existed and indicated that the acid content as given by an electrometric method is a convenient means of following the changes in these other properties during use. Indiana oxidation tests were carried out on the original oils in some experiments in the presence of copper. In the case of an unfiltered Penna. Neutral oil the acid content (*i.e.*, neutralization number) at the end of 48 hours oxidation was about three times as great when copper was present. Eight references. G. R. N.

295. Determination of Carbon and Hydrogen Content by Combustion. M. W. Renoll, T. Midgeley, Jr., and A. L. Henne. *Industr. Engng Chem. Anal.*, 1937, **9** (12), 566.—Directions are given for the operation of a simply improved form of the normal type

of combustion apparatus which gives results for carbon–hydrogen content which are accurate to 0·01%. The combustion procedure itself aims essentially at causing as slow and steady a combustion as possible. Volatile samples are slowly evaporated, and non-volatile samples are charred progressively without inflammation. 0·1–0·2 gm. of the sample is required, the whole test takes from 6 to 8 hrs. and air is used instead of oxygen. The carbon–hydrogen content of natural and synthetic rubbers were determined by this method. G. R. N.

296. Determination of the Saponification Value of Asphalts and Asphaltic Oils. J. E. Fratis and D. H. Condit. *Industr. Engng Chem. Anal.*, 1937, **9** (12), 576.—A rapid method for determining the saponification value of asphalts, etc., based on standard methods is described. The particular features are: (1) the use of benzene alcohol solutions to give contact during saponification and to prevent hydrolysis; (2) addition of barium or sodium chloride to give a clear aqueous layer; (3) the use of dilute reagents to increase accuracy and (4) the use of a special titration flask consisting of a 250-ml. conical flask (glass stoppered) with a horizontal tube approximately 5 mm. in diameter sealed so as to reach one third around the flask near its bottom. By tilting the flask the side tube can be filled with the aqueous layer alone and the end-point can be closely observed. Most petroleum asphalts had saponification values within the range 0·5–1·0 mgm./gm. according to this method. G. R. N.

297. Determination of the Stain Number of Asphalts. H. E. Schweyer and H. C. Howell. *Industr. Engng Chem. Anal.*, 1937, **9** (12), 563.—To determine the staining characteristic of asphalt the sample is placed between pads each consisting of sixteen sheets of a special grade of cigarette paper under a given load at 130° F. The stain number is the number of sheets discoloured by the exuded oil. For asphalts with a softening point below 170° F. a weight of 50 gm. is used, whereas with harder asphalts a weight of 400 gm. is required. The test is carried out over a period of five days. The stain on the sheet of paper must have a diameter greater than 1·6 mm. for the 1 gm. of asphalt sample which is employed. Duplicate tests should check within one half of a stain number. 20 penetration asphalts, steam refined or blown, within the softening point range 150–210° F. gave stain numbers from 1 to 9.

G. R. N.

298. Detection of Lead Derived from Lead Tetra-ethyl. H. Siebeneck. *Oel u. Kohle*, 1937, **13**, 1193.—A 1% solution of dimercaptolthiodiazol is recommended for the detection of lead in waste water from ethylizing installations. A yellow precipitate is obtained with Pb contents down to 3 mgm./litre. The reaction is applicable to the detection of Pb in hydrocarbons. It was also applied to show that lead tetra-ethyl may volatilize together with hydrocarbon vapours at about air temperature; no indications as to the toxicity of such quantities of lead could be obtained.

P. G. H.

299. Relationship Between the Various Viscosity Tests for Bituminous Materials. Hoener. *Asph. u. Teer*, 1937, **37** (47), 675–684.—The paper refers to the difficulty in comparing the various consistency systems, such as penetration, softening point, drop point and road-tar viscosity, used for tars and bitumens, and of relating determinations made at different temperatures. It is stated that the Kennlinien system devised by the author enables such comparison to be easily made, and the relationship between the various grades of tar and bitumen recommended in the D.I.N. specifications is shown. A. O.

300. Preparation of Specimens for Fraass Breaking Point Test. W. Becker and W. Maas. *Asph. u. Teer*, 1937, **37** (44), 623–624.—Details are given of a press which has been found convenient for preparation of specimens for the breaking point test on bituminous materials. A. O.

301. Stability of Aviation Oils. O. C. Bridgeman and E. W. Aldrich. *J. Soc. aut. Engrs*, 1937, **41** (4), 483–492.—In an attempt to correlate laboratory and engine-test data on 22 aviation engine oils, two laboratory tests were investigated alongside engine tests. The first laboratory test (method A) consists in heating with free access of air to the surface, 160 gm. of oil in a 400-ml. Pyrex beaker for periods of 1, 2, 3, 4 and 6 days of 24 hrs.' continuous heating per day at temperatures of 150, 175, 200 and 225° C. The second laboratory test (B) is similar to A., but is carried out under aerating conditions (using aerating stirrers) for shorter periods, *i.e.*, ½, 1, 1½ and 2 days. The highest temperature in method A (225° C.) was considered too severe, and was omitted. The apparatus is described with the aid of photographs. The engine tests were carried out in an air-cooled aero engine of moderate output for 30 hrs., in 3 periods of 8 hrs. and one period of 6 hrs. Samples were taken after each period, and the results were corrected for oil consumption and make-up oil. The engine was untouched throughout the series of tests until evidence of increasing oil consumption was obtained, and then it was rebuilt as closely as possible to the original dimensions. The properties measured after laboratory and engine tests included viscosity, carbon residue, neutralization number and naphtha insoluble. Inspection data on the oils and some graphs relating the properties measured with time are given. It is concluded that the best correlation is obtained using method A for 1 day at 175° C., and it is believed reasonably significant for application to all air-cooled aero engines of moderate output. The reservation is made that since there is a variety of temperatures in different parts of an engine, a laboratory test at a single temperature will not necessarily rate all properties, *e.g.* ring-sticking tendency. A third test (method C) is being worked out in which oil is circulated and exposed to a variety of temperatures during each cycle. Results by this method are shortly to be published.
J. L. T.

See also Abstract No. 307.

Motor Fuels.

302. Patents on Motor Spirit. J. Happel and D. W. Robertson. U.S.P. 2,102,796, 21.12.37. Sweetening sour spirit or kerosine by admixing with it a gas containing free oxygen and with elemental sulphur and passing it through a filter-bed of Pb, Cu, or Ni sulphides supported by bone char.

W. L. Benedict. U.S.P. 2,102,878, 21.12.37. Removing copper compounds from copper-sweetened hydrocarbons by treating them with zinc or iron sulphide in the solid form.

P. M. Raigorodsky. U.S.P. Re. 20,587, 14.12.37. Cf. U.S.P. 1,977,087. Recovering hydrocarbon vapours from pressure distillate using stabilizers or rectifiers.

R. C. Osterstrom and C. R. Wagner. U.S.P. Re. 20,605, 28.12.37; cf. U.S.P. 1,891,108. Removal of gum and colour from cracked distillates. W. S. E. C.

Gas Oil, Diesel Oil and Fuel Oils.

303. Storage Stability and Miscibility of Diesel Fuels. M. Marder. *Oel u. Kohle*, 1937, **13**, 1162.—The view that diesel fuels are not liable to show precipitation of resinous or asphaltic matter on long storage is unsupported in the case of blends of oils from different sources. The proportion of asphalt as given by the "normal benzine" method is unrelated to the actual precipitation which may occur in blended fuels. A paraffinous fuel such as Kogasin II is recommended as a precipitant for testing purposes instead of normal benzine. With a large excess of Kogasin II, precipitation of asphalt is complete within 24 hours. Kogasin II is a fraction of synthetic fuel (Fischer–Tropsch), boiling at 180–320° C. The asphalt contents found in this way were checked against actual storage tests. P. G. H.

304. Relationships Between the Properties of Diesel Fuels and their Mixtures. R. Heinze and M. Marder. *Angew. Chem.*, 1937, **50**, 747.—The authors investigated the relationship between density, cloud and pour point, filterability at low temperature,

storage stability and coking tendency of a series of diesel fuels and their mixtures. Filterability was examined by determination of the lowest temperature at which 200 c.c. of oil under pressure would flow through a 10-mesh sieve in 90 seconds, storage stability by estimation of material insoluble in normal benzine and soluble in hot benzene, and coking tendency by estimation of material insoluble in normal benzine in the oil which had been heated for 1 hr. at 155° C. with air under a pressure of 20 atm. Commenting on the results, the authors state that with distillates from brown coal or crude oil the calculated and determined cloud and pour points are in close agreement, but with cracked oils the mixtures give considerably higher results than the constituents; it is not possible, generally, to calculate the filterability from the results obtained on the constituents. In connection with the latter test it is stated that while in some cases pour point and filterability are in close agreement, in many cases considerable differences exist and the pour point is regarded as unsuitable for examining the behaviour of fuels at low temperatures. Regarding storage stability, it is pointed out that this is of increasing importance, and at present no entirely satisfactory test exists, but the amount of material insoluble in normal benzine is a useful guide; the results obtained show that the mixtures may have higher or lower values than calculated from the constituents. The coking tendency of the mixtures was generally found to be lower than that of the mixtures, and this is attributed to the inhibiting action of certain materials; Kogasin is said to be very effective in this respect. A. O.

305. Estimation of Ignition Values of Diesel Fuels. M. Marder and P. Schneider. *Automobiltech. Z.*, 1937, **40** (8), 1–8.—The authors discuss the results of an investigation of a series of diesel fuels of different origin with regard to correlation of C.F.R. cetene value with cetene value determined from the density–boiling point index relationship by means of the equation $CZ = CZ.300 - (300 - KZ)f$, in which CZ is the required cetene value, $CZ.300$ the cetene value interpolated from a density–cetene value curve, KZ the boiling-point index, and f a correction factor ranging from 0·4 to 0·25 for $KZ.200$–350. Agreement between the determined and calculated values was generally found to be satisfactory for cetene values below 50; divergence with fuels of higher cetene values is attributed to the fact that slight differences in critical compression ratio correspond to considerable difference in cetene value for cetene values above 50, with the result that slight variations in operating conditions cause appreciable errors in cetene value determination. The determination of critical compression ratio is recommended as a more satisfactory method of estimating ignition quality, and is stated to have the advantage that fuels of higher and lower ignition value than can be rated with cetene could be tested in this manner, and would theoretically indicate the suitability of fuels for use in engines of different compression ratio. A. O.

306. Patents on Fuel Oil. F. Uhde and T. W. Pfirrmann. E.P. 476,411, 8.12.37. Process of making heating oils and diesel fuels by dissolving primary bitumen or coal extract in an oil poor in hydrogen according to which a proportion of an oil having a precipitating effect is added to the solution. The precipitate formed is then removed and the oil is then separated by distillation or otherwise.

W. Woelflin. U.S.P. 2,102,051, 14.12.37. Separating oil–water emulsions using as demulsifier a water-soluble salt of Ca, Mg, Sr or Ba and sodium oleate in aqueous or alcoholic solution. W. S. E. C.

See also Abstract No. 312.

Lubricants and Lubrication.

307. Rapid Analysis of Lubricating Oils. J. Roche. *Ann. Off. Combust. liq.*, 1937, **12** (4), 711–734.—Four lubricating oils, one Russian, two Roumanian, and one Texas, and also a pharmaceutical oil meeting the requirements of the German Pharmacœpia, were selectively extracted with acetone, the pharmaceutical oil being more exhaustively extracted by the "fractional diffusion" method of André and Bloch (*Ann. Off. Combust. liq.*, 1933, **8**, 111). Three basic fractions were established. The first fraction was very soluble in acetone, poor in hydrogen, of relatively low mol. wt. and

low optical activity; the second fraction was only moderately soluble in acetone, richer in hydrogen, of high optical activity, and with a mol. wt. and chemical formula equal or near to that of cholestane, thus confirming André and Bloch's work (*ibid.*, 1934, **9**, 491–497). The drastic refining undergone by the pharmaceutical oil leaves this fraction unattacked. The third fraction was almost insoluble in acetone and is of low optical activity. The proportion and mol. wt. of this residue differ in the case of the four oils investigated, being greatest and of highest mol. wt. in the case of the Russian oil. It is considered that the hydrocarbons of the residue are one of the factors affecting viscosity. Further, the method is considered promising for rapid analysis, giving some insight into chemical constitution. J. L. T.

308. High-Pressure Viscosity as an Explanation of Apparent Oiliness. H. A. Everitt. *J. Soc. aut. Engrs*, 1937, **41**, 531–537.—The author describes briefly an instrument developed by L. J. Bradford, which consists essentially of a small fitted bearing of brass (0·135 × 0·271 in.) supported on a knife edge and pressed upwards against a journal of $1\frac{7}{8}$-in. diameter. The bearing is free to tilt, and may be loaded as desired. A thermocouple is located just below the surface of the bearing, and another is fitted externally to the bearing, in the stream of oil supplied to it. The journal is rotated at a constant speed of 465 r.p.m., and the bearing is loaded progressively by increments of 500 lbs.

The difference in temperature between that of the entering oil and the temperature recorded by the thermocouple embedded in the bearing is considered as indicative of the amount of work done within the oil film in passing through the bearing. This temperature difference ΔT has been determined at various projected bearing pressures for oils of Pennsylvanian, Mid-Continent and Western origin, of which the V.I.'s were respectively 103, 74 and — 20. These oils were of equal viscosity at 130° F.

It was found that over the range 6,000–20,000 lbs. per sq. in. projected bearing pressures, at any pressure the value of ΔT was in increasing order, Pennsylvanian, Mid-Continent, Western. Thus the oil with the lowest V.I., and therefore, at bearing temperature, the lowest viscosity, gave the highest value for ΔT. For oils of different viscosities but from the same crude it was found that the value of ΔT increased with increasing viscosity. This fact led to an investigation into the changes in viscosity produced by pressure. These data were obtained under the supervision of Dow, who determined the viscosities of the three oils at pressures up to 50,000 lbs. at each of the three temperatures, 100, 130 and 210° F. It was thus possible to obtain characteristic curves combining pressure, viscosity and temperature (P.Z.T.). The results showed that the Western oil was affected most by pressure, and the Eastern oil least. Using such P.Z.T. curves it was possible to trace approximately the changes in viscosity which each oil underwent in its passage through the bearing, and obtain an estimate for its equivalent viscosity under bearing conditions. The values obtained were qualitatively in harmony with the values of ΔT obtained in the experimental machine.

It is concluded that the so-called oiliness effects were due solely to the effect of the true viscosity actually existing in the oil film. The need for allowing for the effect of pressure on viscosity, as well as temperature, is stressed.

Considerable discussion followed this paper, from which the main points were firstly, that the effect of the rate of shear in viscosity measurement should be investigated, and secondly, that the pressures used by the author were greater than those normally encountered in connection with bearing pressures in automotive lubrication. W. E. J. B.

309. Hypoid Lubricants—Test Results and their Interpretation. C. E. Zwahl. *J. Soc. aut. Engrs*, 1937, **41**, 355–365.—To date the only types of hypoid lubricant which have been approved by Chevrolet are the lead soap-active sulphur and lead soap-sulphur saponifiable-chlorine types. Other types will be approved which meet specifications based on laboratory and service tests. Laboratory tests include load-carrying capacity determined on the S.A.E. machine, viscosity, and viscosity increase and evaporation loss after heating to 300° F. without aeration for 100 hrs., chemical analysis, non-combustible sediment, channelling, foaming and a copper strip test lasting 5 minutes at room temperature. The service test includes in an average of 80 miles of running, speed and axle shock tests followed by inspection for scoring. Lubricants failing to pass the scoring test include the following types: mild type,

lead soap–sulphur saponifiable–chlorine, lead soap without sulphur or with very small amounts of active sulphur, lead soap–sulphur saponifiable, sulphur saponifiable, chlorinated, chlorine sulphur, insoluble zinc oxide and soluble lead containing lubricants. One mineral oil submitted as an extreme-pressure lubricant failed badly inside half a mile. The active sulphur is considered to be the load-carrying agent, and the lead soap is necessary to prevent corrosion in the presence of water. Refill lubricants of types other than those approved were not considered satisfactory. In addition to the speed test, data from long-time service tests indicate that even over distances as large as 40,000 miles the approved types gave excellent results, both as regards absence of scoring and sludging and also condition of bearings. Tested in transmissions (gear boxes) the lead soap-active sulphur type gave satisfactory performance over mileages up to 17,550 and standing periods of 76 days. Bronze parts were blackened, but there was no corrosion. Steel wearing surfaces were in better condition than when using the ordinary pure mineral lubricant. The service data on transmissions to date is insufficient to justify recommending the use of hypoid lubricants therein. Laboratory and service data are detailed. J. L. T.

310. Ageing of Lubricating Oils. H. Suida. *Z. Ver. dtsch. Chem. Beiheft*, 1937, No. 28, 32–33.—The publication is a review of a lecture which treated in a general way the subject of ageing of lubricating oils, commencing with a brief note on the chemical constitution of oils and the chemistry of the process of ageing, which includes oxidation, condensation and decomposition. In the preliminary stages of ageing, co-called petroleum resins are formed, leading next to asphaltic resins, which, in contrast to the former, are insoluble in petroleum ether. They are brittle at room temperature, but sticky and tenacious at their softening point. Further ageing results in the formation of hard asphalt (carbenes and carboids), high-mol.-wt. brittle substances colloidally dispersed in lubricating oils, and forming sludge on coagulation. In use mild oxidation is considered beneficial, on account of an increase in the polar groups. A new oxidation method is proposed. This consists of stirring 150 c.c. of oil heated in an autoclave for 40 hrs. to a temperature of 120° C. under an air-pressure of 8 atm. Good reproducibility is claimed, but no mention is made of practical correlation. It is considered that oils of different nature should not be mixed, since on the basis of a determination of the total products of ageing, the deterioration of such a mixture is greater than that of the arithmetic mean of the components. The total products of ageing are best determined by Pöll's "earth method." Distillates are to be preferred to Bright Stocks, on account of the considered greater tendency of the latter to asphalt formation. J. L. T.

311. Testing and Evaluation of Lubricating Oils for Motor Vehicles. K. Noack. *Z. Ver. dtsch. Chem. Beiheft*, 1937, No. 28, 4–14.—No consistent evaluation could be obtained of the resistance to oxidation of eight oils when examined according to the following six methods:

(1) The Indiana Oxidation Test.
(2) The German precipitation method (Holde, *Kohlenwasserstofföle u. Fette*, 7th edition, p. 268).
(3) The British Air Ministry Oxidation Test.
(4) Evers' and Schmidt's Oxidator Method (*ibid.*, p. 277).
(5) The Hackford Method (*ibid.*, p. 332).
(6) A method employed by a German industrial works.

Details of this last method are given. A new method is proposed which it is claimed gives better correlation with engine performance. Engine test data are confined to oil consumption, and resin and asphalt contents of the used oils after a 50-hr. test. The proposed method consists of drawing air at a suction pressure equivalent to 40 mm. of water over the surface of the oil maintained at a temperature of 250° C. for 1 hr. After heating, the petroleum resins and asphalt are precipitated by normal benzine. Unprecipitated petroleum resins are adsorbed by passing the filtrate through bleaching earth, the adsorbed substances being then extracted by chloroform or a mixture of alcohol and benzol (1 : 1).

The method is considered to give results in agreement with those obtained by the

vacuum distillation method of Walther using 10 mm. pressure. A discussion follows the paper. J. L. T.

312. Blending of Mineral Oils. F. Schick. *Oel u. Kohle*, 1937, **13**, 1157.—Deposits of a solid or semi-solid nature, polymerization products or asphaltic bodies frequently develop in certain blended oils, *e.g.*, motor lubricants and diesel fuels, during use or storage. In many cases, too, the ageing properties of blends, as shown by oxidation tests, are inferior to those of the worst constituent.

Evidence is given that sludge formation in lubricating oil blends is not caused by oxidation. It is suggested that the solubility relationships of polymerized products are changed when the oils are mixed.

The author finds that a light acid and earth treatment, given *after blending*, greatly improves the resistance of motor oils to oxidation (Indiana Test). A similar treatment applied to the component oils before blending did not have the same effect.

Similarly, the formation of deposits in diesel fuel blends on storage is inhibited by refining the finished blend. In this case as little as 0·1% acid is sufficient, and other refining agents, *e.g.*, $AlCl_3$, can be used. Other methods of processing the finished blends, *e.g.*, distillation, were ineffective.

It is suggested that these considerations may prove important in questions which involve the addition of foreign materials to motor oils, *e.g.*, crank-case dilution, oil-changing and replenishment. P. G. H.

313. Requirements of Lubricating Oils for the Iron and Steel Industries. G. Baum. *Z. Ver. dtsch. Chem. Beiheft*, 1937, No. 28, 25–28.—Satisfactory performance in the iron and steel industries in Germany is claimed for lubricants derived from coal tar, so long as they are used in open systems. Figures for bearing temperatures taken from 1921 and 1926 publications are quoted in support of this claim. The use of such oils is increasing in Germany as part of the Government's four-year plan. At present there is also research being carried out on lubricating oils from low-temperature tar (the co-called "Urteer") and on lubricating oils from German petroleum and on synthetic oils. It is pointed out that often too much importance is attached to high flash point and low specific gravity of petroleum oils (by engineers with a slight knowledge of the properties of lubricants). It is further pointed out that the guidance in published form (references are quoted) for the purchasing and testing of lubricating oils for the iron and steel industries is adequate in most cases. Aside from the requirements of I.C. engines, turbines, steam cylinders and compressors where petroleum oils with special properties are demanded, only four oils are really required—namely, a spindle oil and light, medium and heavy bearing oils with viscosities of approx. 2, 3·5, 4·5 and 6·5 E° at 50° C. J. L. T.

314. Requirements of Greases for Automobiles. K. O. Muller. *Z. Ver. dtsch. Chem. Beiheft*, 1937, No. 28, 15–23.—Owing to the vast number of different types of greases at present used, there is always the possibility of substitution of the wrong grade. To eliminate this possibility, a single general-purpose grade is desired. The present tests applied—namely, dropping point or flow point, consistency, ash and water content—are limited and inadequate. To remedy this the following new tests are proposed:—

(1) The Hagemann and Hammerich test for Corrosion (*Oel u. Kohle*, 1936, **12**, 371). In this test strips of copper and of zinc are polished with emery and immersed to the extent of 80% of their length in the grease to be tested for 72 hrs. at 100° C. Thereafter, the copper strip is washed with aqueous KCN solution, and the zinc strip with a benzol–alcohol mixture.

The darkening of the zinc strip is considered to be due to nitrobenzene present in the oil. No measurable corrosion could be detected with other metals, details unspecified.

(2) A new method proposed for consistency gives data on the change of this property with change of temperature, pressure and with working.

No comparative results are available yet on this new instrument, which consists briefly of a cylinder containing the grease through which moves a disc drilled with

holes and loaded with weights. The disc is varied according to the temperature of the test.

(3) Action of Water.

Greases can absorb up to and over 100% of water. A method for measuring this absorption of water consists of coating a strip of glass with the grease to be tested and immersing it almost entirely in distilled water. Separation of oil and distortion of the grease film are observed over periods of 2 days or 1 week at 20° C. or of 5 hours at 50° C. In an attempt at quantitative measurement, a wire cylinder of suitable mesh is coated with the grease and immersed in 750 c.c. of distilled water at 50° C. The change of weight of the cylinder after 5 hrs., after the removal of any water adhering, is noted. No large loss of weight (solubility in water) nor large increase in weight (water absorption) should be noted. It is planned to assess the degree of turbidity of the water after the test by a comparison with standard solutions.

(4) Resistance to heat is measured by determining the weight of oil leaking through a fritted glass disc after 24 hours at 75° C. Other changes to be observed are resinification of the surface and a development of hardness or brittleness in the grease. The advantages claimed for this method over that used by the German railways are greater simplicity and ability to reproduce results.

(5) Drop point is measured by the method in D.I.N.D.V.M.3654. A figure of 130° C. is considered desirable in the single general-purpose grease sought for.

(6) Finally, a practical test is undertaken in a spring-loaded ball or roller bearing packed with the grease. Criteria of quality are small rise of bearing temperature or somewhat greater rise, followed by a drop and subsequent stabilization. Research is being carried out to determine the effect of the viscosity of the mineral oil in the grease on the bearing temperature. It is pointed out in passing that the use of oil instead of grease in central chassis lubrication systems is unsatisfactory owing to the inability of oils to withstand shock loads. Another practical test still in the experimental stage consists in loading by weights a leaf spring which can be sprayed with water, conditions which are considered to simulate actual practice. A discussion follows the paper. J. L. T.

315. Lubrication of Tool-Making Machines. K. Krekeler. *Z. Ver. dtsch. Chem. Beiheft*, 1937, No. 28, 29–31.—Three main influences operate in modern tool making machines :—

(1) Higher speed and smaller clearances.
(2) Distribution of oil in circulatory (preferably pressure-fed) systems.
(3) Newer bearing metals and home-produced (in Germany) materials.

As regards the first influence, lower viscosity oils in pressure-fed systems can take care of the lubrication of high-speed steels and also of gear lubrication, provided tooth design is properly considered. As far as the testing of such oils is concerned, it is considered that ordinary tests are valueless, and oiliness test machines give contradictory results. Long time tests of bearing temperatures are being undertaken to assess oil stability. As regards the second influence, oils of turbine-oil characteristics but of lower viscosity are considered suitable. As regards the third influence, it is considered that the pounding action of the journal is of greater importance than the materials used, which have little or no catalytic action on the oil. Compressed materials for bearings are being investigated, and results on their ability to be wetted as compared with metals are shortly to be reported. In a note on cutting and cooling oils, it is pointed out that the discoloration of bearings using sulphurized lubricants is not serious, and in any case the advantages of longer tool life far outweigh any possible disadvantages. Soluble oils must be prevented from reaching the bearing where they can displace the bearing lubricant and cause drying-up. Oils for fluid drives should be of medium viscosity (not too low to cause serious loss by leakage nor too high to give rise to excessive frictional power loss), and should be of not less than turbine oil quality. A short discussion follows the paper. J. L. T.

316. Oil-Film Lubrication. An Answer to the Camelford–Burwell Discussion. Ir. G. Lieth. *Nat. Petrol. News*, 29.12.37, **29** (52), R. 416.—The author presents mathematical considerations in answer to the phenomena described by Camelford and Burwell

in their paper "Three Phases in which a Lubricant may Operate" cf. *Nat. Petrol. News*, 24.2.37, **29** (8), 20. The arguments are based on Summerfield's analysis of the lubrication of plain bearings. H. G.

317. Patents on Lubricating Oil. Texaco Development Co. E.P. 476,281, 6.12.37. Manufacture of oil-soluble resinous material and of lubricating oils by dissolving in petroleum lubricating oil, a small proportion of a resinous polymer.

N. V. de Bataafsche Petroleum Mij. E.P. 476,984, 20.12.37. Production of lubricating oils with a greater oxidation stability than the initial synthetic hydrocarbon used in their production, by adding to the synthetic oil extracts of natural hydrocarbon oils boiling above 300° C.

Edeleanu Gesellschaft m.b.H. E.P. 477,086, 21.12.37. Refining lubricating oils by deasphalting using a liquid aliphatic fluorohalogen compound or an aromatic fluorine derivative and treating the resulting solution with a selective solvent, *e.g.* phenol, furfurol, etc.

U. B. Bray and C. E. Swift. U.S.P. 2,101,308, 7.12.37. Refining lubricating oil by deasphalting with petroleum naphtha, removing the asphalt and extracting the oil with nitrobenzene.

J. Grahame. U.S.P. 2,101,497, 7.12.37. Refining of lubricating oils by first dewaxing and then forming a mixture of dewaxed oil and β-trichlorethane and extracting the mixture with furfural.

E. F. Engelke. U.S.P. 2,101,643, 7.12.37. Fractionation of lubricating oil using a secondary alcohol having at least 4 carbon atoms in the molecule.

E. Petty. U.S.P. 2,102,334, 14.12.37 and J. M. Whiteley and H. G. Vesterdal. U.S.P. 2,103,504, 28.12.37. Dewaxing hydrocarbon oil using propane.

De W. H. Palmer. U.S.P. 2,103,635, 28.12.37. Apparatus for re-refining crankcase drainage oil.

F. G. Fellows. U.S.P. 2,103,898, 28.12.37. Apparatus for the distillation of lubricating oils. W. S. E. C.

See also Abstracts Nos. 294, 301 and 338–473.

Asphalt and Bitumen.

318. High-Viscosity Road Tars—Lime Treatment Method. Anon. *Chem. Tr. J.*, 14.1.38, **102**, 28.—A process has been patented (E.P. 471,216) for increasing the viscosity and resistance to flow of road tars by heating tar with water and lime. Salts are formed, intimately dispersed throughout the tar, which give it a structural framework exhibiting plastic and thixotropic properties. The tar is heated to 70° C. and water and lime are added with thorough stirring, no apparent change resulting for ½ hr., after which the viscosity commences to rise rapidly. The product obtained from continuous vertical retort tar has been found to be an excellent binder for road material when treated with 2–5% lime. A tar from the carbonization of West Yorkshire coal in continuous vertical retorts was successfully treated with 1·6% lime, whereas a horizontal retort tar from the same coal showed no increase in viscosity with 10% lime. All tars, however, and also bitumens and mineral fuel oils, can be treated by adjusting the tar acid content by blending with other tars or tar acids. C. L. G.

319. Patents on Asphalt. W. Hassard. E.P. 476,173, 2.12.37. Stabilizing asphalts by adding magnesium silicate and casein.

Rütgerswerke A.-G. E.P. 476,361, 7.12.37. Process for converting liquid pitch or pitch-like substances into a fragmentary transportable form. W. S. E. C.

See also Abstracts Nos. 296, 297, 299 and 300.

Special Products.

320. Petroleum Oils for Anti-Malarial Mixtures. Anon. *Petrol. Times*, 25.12.37, **38** (989), 824.—The extent to which an oil will spread on water depends on its "spreading pressure," which should be a maximum. "Spreading pressure" can be increased by the use of addition products. Fatty acids and vegetable oils are unsuitable for this purpose owing to their polar properties. Other agents are being studied. These include petroleum products, natural and synthetic resins and rubber derivatives. Considering the question of how long a film will retain continuity on a large water area, it has been found that films of certain oils retract into relatively thick patches. This always occurs if the aromatic constituents of the oil are more volatile than the aliphatic components. There are reasons for believing that there should be an upper limit to the olefin content of an oil for proper penetration of the trachea of the larvae.

H. G.

321. Catechol from Coal. Anon. *Chem. Tr. J.*, 28.1.1938, **102**, 65.—An apparatus has been designed at the Chemical Research Laboratory, Teddington, for the extraction of catechol from the concentrated aqueous liquors from the low-temperature carbonization of coal. Extraction of the hydraulic main liquors from various coalite plants gave yields of 0·03–1·8 gm. per litre of liquor. The most successful method used was vacuum concentration of the liquor to $\frac{1}{10}$th volume, followed by ether extraction. After removal of the solvent the extract was distilled under 10 mm. pressure, yielding a fraction distilling between 130° and 175° C., which deposited catechol on cooling, and a fraction distilling between 175° and 204° C. giving resorcinol. The crystals are freed from adhering phenolic oil, and purified by recrystallization from toluene or sublimation from a steam-heated tray. To obtain colourless catechol it is necessary to use copper, brass or aluminium condensers, etc., in place of mild steel. The yield of resorcinol from one aqueous liquor was 0·7 g.-litre.

Catechol is used as a stabilizer for motor fuels and as a colouring agent in fur dyeing, and has possibilities as a dye intermediate. Resorcinol is widely used for the latter purpose, and also condenses actively with formaldehyde to yield resins.

C. L. G.

322. Chemicals and Bug Disinfestation. Anon. *Chem. Tr. J.*, 14.1.1938, **102**, 32.—At a meeting of the Royal Sanitary Institute in January a discussion on recent advances in methods of bed-bug disinfestation, it was pointed out that washed heavy naphtha was a suitable material for this purpose, being harmless to human beings, lethal to eggs of the bug, cheap, readily available, easy to apply, readily removed by ventilation and incapable of causing damage to furniture, etc. The critical factor is the temperature necessary to secure a sufficient concentration of the vapour, which in the case of heavy naphtha at 50°, 61°, 70° and 75° F. is 0·16, 0·21, 0·29 and 0·36 respectively. The minimum lethal concentration was shown to be 0·15, so that temperatures should be at least 60° F. Screens erected a few inches from the walls and bearing light cotton sheeting soaked with naphtha and automatically replenished after several hours have given improved results.

C. L. G.

323. Patents on Special Products. G. W. Johnson. E.P. 476,189, 3.12.37. Manufacture of secondary mixed aliphatic cyclic alcohols by treatment in the liquid phase with hydrogen in the presence of a nickel catalyst at 100–250° C. of ketones containing at least two rings in the molecule and a carbonyl group not directly connected with a ring.

Standard Oil Development Co. E.P. 477,014, 20.12.37. Preparation of nitrated compounds of hydroformed naphtha separated from petroleum oil.

Standard Oil Development Co. E.P. 477,015, 20.12.37. Preparation of phenol derivatives of hydroformed petroleum naphthas.

C. H. Harrison. E.P. 477,100, 22.12.37. Manufacture of calcium carbide by heating calcium sulphide with carbon or a carbonaceous material, *e.g.* coke, brown coal, to 1600–1750° C. in an atmosphere of hydrogen.

Metallgesellschaft, A.G. E.P. 477,207, 23.12.37. Production of drying oils with high iodine values as a substitute for linseed oil by decomposing fish oils.
W. S. E. C.

Detonation and Engines.

324. Variables Affecting Flame Speed in the Otto-Cycle Engine. C. L. Bouchard, C. F. Taylor and E. S. Taylor. *J. Soc. aut. Engrs*, 1937, **41**, 514–520.—Using a similar apparatus to that employed by Withrow and Boyd, the authors have examined the effect of several variables on flame speed in a small L-head engine fitted with a window in the cylinder head extending from a position above the spark plug (which was fitted horizontally between the valves) to the far side of the cylinder. The effects on flame travel of such variables as altitude, with and without supercharge, inlet temperature, humidity, speed of rotation, spark timing and air–fuel ratio are shown graphically.

The main conclusions arrived at are as follows :—

(1) Under normal combustion conditions the general flame movement remains the same with a substantially constant maximum velocity between 10% and 90% of the total travel. For the first and last 10% travel the speed is very much slower, and falls off rapidly as the flame front approaches the far cylinder wall.

(2) The flame speed is increased by increase of pressure at which combustion commences, decrease in initial temperature, decrease in proportion of residual gas, and increase in small-scale turbulence.
C. H. S.

325. Spark Advance Indicator and Knock Rating Observations. S. Oldberg, G. Way and J. B. Macaulay. *J. Soc. aut. Engrs*, 1937, **41**, 521–526.—This article gives a full description of a purely electrical apparatus for indicating the position of the spark relative to crankshaft position in a car on the road, together with data relating to tests carried out with the instrument, on four different cars, compared with laboratory data on the distributors concerned.

Assuming road ratings to be accurate to one octane number, the tests show that fuels of low-temperature sensitivity rate the same regardless of spark advance, knock intensity, or car used. A benzol blend tended to appreciate as spark was advanced and knock intensity increased. A vapour phase cracked fuel depreciated at high knock intensity and maximum knock speed rose from 15 to 60 m.p.h. as spark was advanced.
C. H. S.

326. Problem of Ring Sticking in Aviation Engines. O. C. Bridgeman. *J. Soc. aut. Engrs*, 1937, **41** (6), 545–547.—An analysis of the first principles is followed by a consideration of some of the more important variables. As regards the effect of temperature it is considered that for oils of moderate stability there may be a critical temperature range above and below which there is freedom from ring-sticking. As far as solvent refined oils are concerned, the author considers that there is no evidence that such critical temperature conditions exist. If the refining process is carried too far, then the higher temperatures tend to break the oil up into drops, and the disrupted film permits "blow-by," and ring-sticking is accelerated.

As regards the effect of oil characteristics, viscosity is the most important. The author considers that aviation oils are one if not two grades too thick, and that the spread of the tendency in the automobile industry towards the use of lighter oils to the aviation industry would, at any rate, mean the acquisition of valuable data, if not of like benefit. The utility is considered of the possibility of a reversal under sufficiently high temperatures of the polymerization in the case of synthetic polymers, to give a reduction in viscosity. From the standpoint of the petroleum industry, lack of adequate laboratory test methods for ring-sticking is the main hindrance to the rapid development of improved oils. As regards the effect of ring design, it is considered that there is plenty of room for improvement to give freer flow of oil round the ring, greater circularity, and more even distribution of tension, and also freer movement in the groove.
J. L. T.

327. Vibration in Engine Structures. L. J. Le Mesurier and R. Stansfield. *Oil News*, 1937, **41**, 208–209.—A report on a paper by the above authors which was read before

the North-East Coast Institution of Engineers and Shipbuilders. The paper dealt with the measurement of vibrations and comparison of stresses due to these vibrations under running conditions in various parts of engines. The method employed consisted of the application of the Standard–Sunbury Indicator, employing an electro-magnetic search unit capable of measuring minute elastic deformations in the frame or running parts of the engine, such deformations being capable either of being calculated into their stress equivalents or of being compared under various conditions. Tests were made on four distinct types of diesel engines. The authors conclusions are stated.

W. W.

328. Vagaries of Internal Combustion. J. Small. *Engineer*, 3.12.37, **164**, 643; 10.12.37, **164**, 669.—Characteristics of the ignition and combustion processes of spark and compression ignition engines are compared and discussed in conjunction with their respective fuel requirements. Possible causes of the greater cyclic irregularity of the combustion stage usually associated with spark ignition and means of securing improved consistency are suggested. From tests made by the author in which the vaporization of petrol in a long air duct was examined, it is possible to deduce that in the induction manifold of a cold engine the vaporized petrol represents less than 1% of the total mixture.

The effect of various factors including fuel dopes on the ignition lag and performance of petrol and compression ignition engines is dealt with in some detail, and in conclusion the author describes typical examples of modern engine indicators.

E. F. C.

Coal and Shale.

329. Roumanian Production of Coal from 1934 to 1936. G. H. Dumitrescu. *Monit. Petr. roum.*, 1937, **38**, 1873–1874.—Production of coal in Roumania has increased from 1,852,194 tonnes in 1934 to 1,963,693 tonnes in 1936. The figures for the three years under review are analysed and tabulated in qualities and areas. The increase is due to ordinary coal, brown coal and anthracite. Lignite production has remained fairly constant.

The greatest production is in Transylvania, which accounted for 1,351,881 tonnes of the 1936 output. Production of coke shows a sharp increase from 31,725 tonnes in 1934 to 63,214 tonnes in 1936, but does not yet fulfil the demands of the metallurgical industries; hence Roumania imported 38,742 tonnes of coke in 1936. Most of the coke imported came from Germany, Poland and Czecho-Slovakia, Germany supplying 22,759 tonnes.

The railways consumed 1,302,244 tonnes of coal in 1936, compared with 236,917 tonnes of fuel oil.

Roumania's coal reserves are estimated as up to 2,984,403,000 tonnes.

T. C. G. T.

330. Patent on Coal. W. B. Mitford and C. H. Lander. E.P. 476,427, 6.12.37. Production of solid smokeless fuel and a hydrocarbon distillate containing substantial fractions of low b.pt., by means of a low-temperature carbonization process using a rotary retort.

W. S. E. C.

Economics and Statistics.

331. France and Roumania from the Petroleum Point of View. M. Pizanty. *Monit. Petr. roum.*, 1937, **38**, 1877.—During the recent visit of M. Delbos, the French Foreign Secretary, to Roumania, the *Argus*, an economic paper, published a special number which received the collaboration of the highest officials of both governments. This article reviews this number.

France's petroleum consumption of 6,000,000 tonnes is third among European countries. She has fifteen refineries with an annual treating capacity of 6,500,000 tonnes, and 2,300,000,000 francs are invested in her petroleum industry.

France's interest in Iraq's petroleum and her attempts to discover oil at home and in her African possessions are outlined.

Though Roumanian production of petroleum is being lowered, her importance to France is undiminished. During 1937, petroleum was accounting for 74% of the total value of Roumanian exports to France. T. C. G. T.

332. Oil Situation in Colombia. Anon. *Rev. Petrolif.*, 7.1.38, (767), 6.—Production figures are given from 1929 (the peak year) to 1937. Although 100,000 sq. km. offer oil possibilities, only 10,000 sq. km. have been exploited.

Production is almost exclusively from a field in the Magdalena valley near Barrancarbermeja. R. O. Y.

333. Exploitation Conditions in Bolivia. Anon. *Rev. Petrolif.*, 31.12.37, (766), 1830.—The oil-producing regions, when the Standard Oil concessions were cancelled, are in the Chaco, 2000 km. from La Paz.

In the Parapeti River region the Bolivian and Brazilian Governments are to co-operate in the exploration and testing. The conditions of the agreement are given. R. O. Y.

334. Petroleum Exploitation in Mexico, 1937. Anon. *Petrol. Times*, 12.2.38, **39** (996), 211–212.—Details of wells drilled in Mexico during 1937 are given and production figures show that the steady increase since 1932 has been maintained. The important new Poza Rica area is to be exploited in the most efficient manner by Mexican Eagle, El Aguila and a Government department. The details of this working agreement are given. The estimated reserves of the area are stated to be 500,000,000 brls. Statistics for the consumption of petroleum products in Mexico are given. R. O. Y.

335. Present Position of Petroleum Prospecting Licences in Egypt. Anon. *Petrol. Times*, 8.1.38, **39** (991), 48–49.—Maps are given of Northern Egypt and the coastal belt of the Red Sea showing the location of prospecting areas taken up by some of the largest British and American companies. R. O. Y.

336. New British Licences for Gulf Exploration Co. Anon. *Petrol. Times*, 5.2.38, **39** (995), 177–178.—Details are given of the new exploration areas (669 sq. miles) granted to the Gulf Co. in Lancashire and Yorkshire. R. O. Y.

337. New Facts Concerning Soviet Oil Reserves. I. M. Gubkin. *Oil News*, 27.1.37, **43** (1313), 55–56.—The author considers that the figures cited for the Soviet Union's proven oil reserves, at the International Geological Congress, were perhaps too conservative. In the Baku region the old fields still show high productivity, long after they were expected to be exhausted, owing to the discovery of deeper horizons. The Northern Caucasus production has greatly increased recently, and important developments are taking place in the Ural region. The author concludes that the U.S.S.R. may derive her present requirements from the more accessible regions, thus overcoming transport and distribution difficulties. R. O. Y.

GENERAL DISCUSSION ON LUBRICATION AND LUBRICANTS.*

(13th–15th October, 1937.)

THE INSTITUTION OF MECHANICAL ENGINEERS.

Abstracts of Reporters' Summaries and Papers.

Group I.—Journal and Thrust Bearings.

Report on Papers in Group I. Journal and Thrust Bearings. H. W. Swift. *Proc.*,† 1938, **1**, 343–353.

Theory.

Osborne Reynolds, in 1886, enunciated the principles of the pressure film and developed the basic theory of the lubrication of both journals and thrust bearings. Twenty years later the mathematical theory of the journal bearing was advanced and simplified with the aid of an ingenious parameter by Sommerfeld, and the problem of the plane thrust pad was so completely solved by Michell that his theory forms the quantitative basis of the design of thrust bearings to this day. In the field of journal bearings the physical hypotheses of Sommerfeld's theory have required amendment in the light of later researches, notably those of Gumbel and Goodman, and various assumptions have been made regarding the effective length of the pressure oil film. Before the theory of journal bearings can, however, lay any claims to completeness, two factors must be considered: the effect of side leakage and the effect of changing viscosity in the oil film. Some progress has been made with each of these problems. The problem of side leakage has yielded in part to an approximate analysis by *Boswall* and in part to an ingenious electrical analogy due to *Kingsbury* and *Needs*. By making certain simplifying assumptions, *Boswall* has obtained useful comparative results for the effect of temperature changes in both plane pads and journal bearings, and American workers have been led to predict an improvement in bearing capacity, albeit accompanied by an increase in friction, at high pressures.

Experiment.

Rapid progress has been made in experimental work. The capacity and friction characteristics of bearings under steady loads can now be explored with confidence, and interesting and varied examples of recent experimental technique are given by *Prandtl*, *Hanocq*, *Odqvist*, *Linn* and *Sheppard*, *Clayton*, *Jakeman* and *Fogg*, and *Thomson*.

At the present time, particular attention is being devoted to the conditions of breakdown of the pressure film, to the unsteady conditions which arise from vibration or cyclic fluctuations of load and, in co-operation with the designer, to the development of new bearing materials and lubricants. Investigations of the conditions of seizure in journal bearings, notably by *Clayton* and others at the National Physical Laboratory, give general support to the descriptive theory of film breakdown expounded by *Heidebroek*.

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* The *Proceedings of the General Discussion on Lubrication and Lubricants* are distinct from the *Proceedings* of the Institution of Mechanical Engineers, and are published separately in two bound volumes at a price of 25*s*. the set. Copies are obtainable from the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, and from the American Society of Mechanical Engineers, 29 West 39th Street, New York, U.S.A.

† In the following Abstracts the *Proceedings of the General Discussion on Lubrication and Lubricants* are abbreviated to "Proc."

Design.

The design of a bearing can seldom be based purely on considerations of minimum friction and optimum film thickness, and many conditions must arise in practice where the maintenance of any kind of pressure film is technically impossible. The working temperature of a bearing is often a primary consideration not only by reason of its effect on the viscosity of the lubricant and so on the working eccentricity and load capacity, but also on account of the distortion which temperature differences may produce in the geometry of the film. In order to ensure a safe working temperature, the designer may need to employ for cooling purposes far more oil than is required to maintain the lubricating film, and he may need to design his bearing to provide means of free oil circulation even at the expense of load capacity. *McKee* suggests an approximate expression for heat dissipation in terms of temperature rise which differs as it must, according as the bearing is self-contained or independently cooled, while *Soderberg* puts forward an empirical formula suitable for turbo-bearings. The mechanism of oil supply by means of oil-rings and collars has been successfully investigated by *Karelitz* and *Baildon*.

Bearing Materials.

The ideal bearing material needs a combination of almost incompatible properties. It needs good mechanical strength over the working range of temperatures, and sufficient structural stiffness to prevent general distortion, and yet sufficient plasticity to bed itself without wear. It must be capable of high surface finish, and yet be free from abrasive action either in the mass or in its fine products of wear. It must have a low intrinsic coefficient of friction and high thermal conductivity. No such material has, of course, been found, but a good deal of progress has been made in recent years towards the development of properties most desirable for specific applications, and some interesting results have been submitted for discussion.

In engineering practice bronze bearings have been generally favoured for heavy pressures and slow speeds, whilst white metals have been used with higher speeds or less perfect alignment. In the range of copper alloys *Neave* and *Sullitt* are able to report some interesting developments. Important developments have taken place in non-metallic bearing materials, and several contributors are impressed by the potentialities of fabric bearings. Rubber-lined bearings are specially suited to water-exposed conditions which have in the past provided the traditional field for lignum vitae. *Brazier* and *Bowyer* have found that with water as combined lubricant and coolant a suitably designed rubber bearing compares favourably with metal bearings in the matter of friction and can withstand high pressure at moderate speeds.

Thrust Bearings.

Designers, represented in this instance by *Dawson*, *Gibson* and *Kraft*, are fully conscious of their indebtedness to *Michell* and those who later elaborated his theory of the pivoted pad thrust bearing, and it is significant that the proportions and pivot location shown in Michell's original patent specification are still standard practice.

Turbo Generator Bearings.

Guy and *Smith* have compiled a comprehensive statement of the practice of the principal steam-turbine manufacturers in this country, and *Soderberg* shows that a similar practice is followed in America. *Samuelson* gives details of a series of tests on a shop turbine in which water containing 2% of soluble oil was successfully used as a lubricant. This is of special interest in connection with the fire hazard, which is discussed by *Chittenden*. The problem of oil-film vibration, which is of special concern to designers of turbo-bearings, has sometimes been solved by reducing the bearing arc or introducing a self-imposed load as in the Newkirk bearing.

Internal-Combustion Engine Bearings.

Internal-combustion engine design is largely based on experience and trial, and there is a marked reticence in some quarters to disclose the methods employed. The empirical character of these methods is ascribed by *Taylor* partly to want of rigidity in the bearings and uncertainty of the relationship between heat dissipation and temperature rise, but more particularly to the cyclic fluctuations of the bearing load.

Mickelsen gives evidence that in high-speed engines the inertia forces predominate over those due to combustion to such an extent as to form the better basis for design. The disadvantage of the ordinary system of forced lubrication is emphasized by *Dicksee*.

Railway Axle-boxes.

Difficulty of achieving pressure film conditions has arisen partly from the necessity for starting with full load on the crown of the bearing and partly from the practical inconvenience of ensuring a profuse supply of oil. *Stanier* points out that the horizontal component of load on the coupled axles gives them some advantage over the axles of carrying wheels as regards starting conditions, but its variable character complicates the problem of locating the distributing grooves. Self-contained devices to improve starting and running conditions by ensuring immediate and profuse oil supply appear to be more popular on the Continent than in this country.

338. Performance of Oil Rings. E. Baildon. *Proc.*, 1938, **1**, 1–7.—The paper outlines briefly a descriptive explanation of oil ring operation and describes the results of experiments made in this respect.

Examination of the relationship between journal and ring speeds showed that at low journal speeds, assuming the laws of solid friction to hold, no slip occurred. At some journal speed the frictional force became limiting, and at all higher journal speeds the ring moved with a constant maximum speed, and slip took place.

A critical range of journal speeds was found to exist beyond which centrifugal action considerably reduced the quantity of oil which could be retained by the journal from the stream flowing at the sides of the ring. This critical range was found to be inversely proportional to the square root of the journal diameter.

Provided the journal speed was below the critical range, the smaller the proportion of ring slip the greater was the rate of oil transfer.

The smaller the ratio of ring to journal diameter the more favourable were the conditions for adhesive oil transfer to the journal at all journal speeds and at low journal speeds it was considered that the radial thickness of the ring had more effect on performance than had the axial width. At journal speeds higher than the critical range, however, the axial width governed the transmission rate which was roughly proportional to the width of the ring.

Experiments previously made suggested that cast iron, steel and gun metal are satisfactory materials for the construction of oil rings.

It was found that unless the axial travel of the ring along the journal was controlled, its operation could be adversely affected, and the use of suitable guides in a bearing is suggested. To supplement the oil transfer by adhesive action at high journal speeds various scooping and scraping devices have been developed which collect from the ring oil not available for adhesive transfer. Internal grooving of the oil ring was found an effective means of increasing the oil delivery when scrapers were employed. It was found that except at very low journal speeds oil transfer was less with oils of lower viscosity. Due consideration of possible bearing temperature in the design of the ring oiling equipment for a bearing is therefore emphasized to ensure adequate oil delivery. E. F. C.

339. Lubrication of Synthetic-Resin Bonded Bearings. P. Beuerlein. *Proc.*, 1938, **1**, 8–16.—Data are given of the shrinkage and swelling of synthetic resin bonded bearings which takes place when these bearings are lubricated with the following media: pure, compounded and sulphurized mineral oils, various types of greases, water and emulsions of different values of hydrogen-ion concentration. Expressions are given enabling the bearing clearance and load capacity of bearings of this type to be calculated. J. W. H.

340. Characteristics of the 120° Journal Bearing. R. O. Boswall. *Proc.*, 1938, **1**, 17–22.—The equations applicable to the 120° bearing are stated, and the characteristics are given in tabular form cases of central loading, and offset loading at 65° and 70°. From the tables attitude and coefficient of friction can be read for bearings of length-diameter ratio 2·0, 1·5 and 1·0. P. D.

341. Relationship of the Pressure-Viscosity Effect to Bearing Performance. L. J. Bradford and C. G. Vandergrift. *Proc.*, 1938, **1**, 23–29.—The relation between pressure and viscosity for a liquid may be represented by a logarithmic formula, and this, combined with the hydrodynamical formula for a flat bearing of infinite width, permits the calculation of the pressure distribution. There is a marked increase in the capacity of the bearing when the clearance is small, and this is illustrated graphically. This gain is partly offset by increased heating, and the combined heating and pressure effect is calculated.

These advantages are only realized when bearing clearances are small, which entails great smoothness of surface. An experimental result is quoted in which a bearing sustained a load of 24,000 lb. per sq. in. for several hours without injury.

P. D.

342. Rubber as a Material for Bearings. S. A. Brazier and W. Holland-Bowyer. *Proc.*, 1938, **1**, 30–37.—Data on the frictional resistance of water-lubricated vulcanized rubber and steel bearings are given, and it is shown that, whereas the frictional resistance for metal bearings increases with increasing load, the frictional resistance of the rubber bearing decreases with increasing load. The design, application and running properties of such bearings are discussed. J. W. H.

343. Contribution to the Theory and Practice of Bearings. H. Brillie. *Proc.*, 1938, **1**, 38–51.—The various factors necessary to evolve a complete theory of bearings are discussed. References are given to those factors which are capable of mathematical treatment, and it is concluded that when the remaining factors, which have to be neglected in order to arrive at a simple bearing theory, are considered, the agreement between theory and experiment is found to be satisfactory. With a knowledge of the theoretical formulæ and the experimentally determined factors by which the theoretical coefficients must be multiplied to give the observed coefficients, it is possible to apply the principle of mechanical similarity.

Experimental observations in full agreement with modern theory demonstrate that: (1) the development of pressure and passive resistances over the whole bearing surface does not take place in accordance with the conditions resulting from the integration of Reynolds' formula. The development of pressure only takes place on part of the surface, and this results in an increase in the passive resistance, which may be reduced by the provision of shallow oil reservoirs in the appropriate regions. (2) It is difficult to obtain films of large arc and even on a 6 cm. diameter bearing possessing a bearing surface as small as 60° arc, the film only extends over 54° of arc.

J. W. H.

344. Steam Turbine Lubricating Systems and Fire Risk. J. P. Chittenden. *Proc.*, 1938, **1**, 52–58.—The functions required of the lubricating system for a modern turbo-generator are briefly outlined. System fulfilling these requirements may be divided into two classes; one in which the lubricating and governing oil is supplied by a separate system which may serve more than one turbine, and the second, and more usual one, in which the various components form an integral part of the turbine installation.

A typical lubricating system in the latter class is illustrated and described, and the factors governing the oil capacity of the system are discussed. An essential feature in the arrangement is that the capacity of the system must be sufficient to provide a reasonable settling time for the separation of gases, etc. One change of oil through the system every 6 or 8 minutes is generally allowed in large modern machines.

The importance of preventing foreign bodies from the internal surfaces of the machines from entering the lubricant is stressed, as is the importance of the removal of gaseous impurities in the oil such as air, water vapour and chemically cracked lighter fractions of the oil which are acid in nature and promote the formation of sludge. The use of suitable venting, large return pipes, and efficient baffling in the tanks facilitates the release of gases and the settling out of water and sludge. In most modern installations centrifugal separators are fitted for oil purifying. These are generally designed to bypass through the purifier about 5–10% of the total quantity of oil in circulation.

In conclusion the author emphasizes the potential danger of fire risk with high-

pressure oil pipes, and makes numerous suggestions to secure greater protection against this contingency. E. F. C.

345. Effect of Seizure on the Shape of the Crown of a Bush, and the Influence on Subsequent Running. D. Clayton. *Proc.*, 1938, **1**, 59–65.—This report describes further investigations made with a journal bearing machine in which variations of diameter round a bronze bush were made at three positions in its length by a sensitive measuring apparatus when the bearing was heated artificially so as to obtain a coefficient of friction–temperature curve.

It was concluded that in a journal bearing test in which the temperature was raised artificially, high point contact between journal and bush occurred immediately on passing the minimum friction, also the points of contact were eccentric to the centre line. With one direction of running the crown of the bush was worn mainly on the outlet side of the centre line. On reversing the direction of rotation, this modification of shape, coming now on the inlet side, led to increased safety of the bearing, the seizing temperature under the particular conditions rising from 100° C. to 160° C. Seizure with this direction of rotation rendered the modification of the crown of the bush symmetrical about the centre, line and the safety for the original direction was improved. E. F. C.

346. Lubrication of the Automobile Engine. C. B. Dicksee. *Proc.*, 1938, **1**, 66–71.—Lubrication systems, with their double duty of reducing friction and removing heat, are described in relation to the various parts of the engine. Factors controlling the oil pressure necessary to maintain oil flow under all conditions and means of regulating the supply are examined.

Frequent changing of the oil and reclamation of the drained oil are recommended rather than attempting to provide adequate filtration on the engine. Sump temperatures are discussed in relation to the oil and bearing metals used; a light oil is favoured on account of reduced friction. J. G. W.

347. Thrust Bearings for Steam Turbine Machinery. R. Dowson. *Proc.*, 1938, **1**, 72–83.—The chief features of the design and operation of tilting-pad thrust bearings, based on the accumulated experience of a number of makers during twenty-five years of development, are discussed.

The present practice of seven leading steam-turbine manufacturers in the points enumerated is summarized in tabular form.

Although the tilting-pad type of thrust bearing generally has displaced the plain collar type, the latter is still used by some manufacturers for small turbines, and the paper concludes with details of modern practice in this design. E. F. C.

348. Properties and Performance of Bearing Materials bonded with Synthetic Resin. G. R. Eyssen. *Proc.*, 1938, **1**, 84–92.—The replacement of metal bearings by synthetic resin bonded laminated bearings for heavy-duty work results in a reduction in power consumption of 25–60% and 6–10 times longer bearing life. By the recent introduction of this type of bearing material in a mouldable form, it is possible to widen the field of application of such bearings to textile machinery, pigment grinders and chemical engineering plant where corrosion is a problem. The presence of graphite in the moulded bearing material extends the use of these bearings by making them self-lubricating. This bearing moulding material may be formed into valve cones, which are self-lubricating when fitted in valve housings made of cast iron, bronze or light metals. J. W. H.

349. Principles of the Design of Journal Bearings. E. Falz. *Proc.*, 1938, **1**, 93–100.—A general consideration of design dealing with ratio of the radii of journal and bearing; effects due to deflection; means of overcoming deflection; the method of supplying lubricant, including design of oil-grooves in the bearing; and the desirability of smooth finish. The points raised are illustrated by an oil ring bearing.

P. D.

350. Some Experiments with Water-Lubricated Rubber Bearings. A. Fogg and S. A. Hunwicks. *Proc.*, 1938, **1**, 101–106.—The results of tests in the National Physical Laboratory journal testing machine on water-lubricated, 2-inch diameter, rubber bearings of various designs are given. It is concluded that bearings of this type are quite satisfactory up to loads of 200 lbs. per square inch and are most efficient at a speed of 500 r.p.m. Plain bushes give a lower coefficient of friction than the fluted bushes generally used, but the latter type of bush probably prevents scoring in the presence of grit. J. W. H.

351. Pivoted-pad Bearings. J. H. Gibson. *Proc.*, 1938, **1**, 107–114.—A brief review of the difficulties encountered with the use of thrust bearings before the introduction of pivoted-pads is given. Reference is made to the valuable work of Michell in this connection and in his application later of the principle to journal bearings.

The single-collar thrust bearing with tilting-pads is admirably adapted to marine propulsion, and works equally well on vertical shafts. Vertical spindle pivoted-pad thrust bearings are now extensively used in hydro-electric power and pumping stations.

Several examples of the applications of pivoted-pad journal bearings are described and illustrated; these are now standard practice in all classes of warship. Because of their wear-free properties, they are particularly valuable for tunnel shafting which is sometimes difficult of access and where maintenance of alignment is always of considerable importance. Pivoted-pad tunnel bearings are now fitted in many ocean liners. E. F. C.

352. Steam Turbine Journal Bearings. H. L. Guy and D. M. Smith. *Proc.*, 1938, **1**, 115–121.—This paper consists principally of a review of the current turbine journal bearing practice of the six principal turbine manufacturers in this country. A table summarizes certain aspects of design, which are also dealt with in some detail.

The authors stress the importance of carrying out experimental work on full-scale plant rather than with experimental bearings which do not sufficiently reproduce the conditions of modern turbine practice. Results of two typical series of tests carried out by the authors' firm on two types of large turbine bearings are described, in which the effect of oil quantity on bearing loss was examined. It was found that increase in the oil quantity supplied can, in a particular design, actually increase this loss. There are very definite limits to the reduction in quantity for a particular high-speed bearing and in commercial work the quantity of oil supplied to a bearing must be very considerably greater than the minimum with which the bearing can be run under controlled conditions.

In conclusion the authors indicate the directions in which future co-ordinated research upon outstanding problems is required. E. F. C.

353. Experimental Study of Journal Bearings. Ch. Hanocq. *Proc.*, 1938, **1**, 122–132.—This paper gives a summary of theoretical and experimental work on full and partial bearings published by the author over the years 1929 to 1931. P. D.

354. Nature of Limit Friction. E. Heidebroek. *Proc.*, 1938, **1**, 133–137.—The author considers that the increase in the coefficient of friction μ in the region of limit friction at low velocities is in accordance with the hydrodynamic theory, and is not due to dry friction between the surfaces.

In developing the argument, the author considers surface irregularities of the journal and the bearing, and thus shows that the frictional force depends on the least film thickness, and therefore, on the position of the journal in the bearing.

It is considered that the point at which the values of μ start to increase depends on the surface irregularity, and thus on the journal attitude at which the width of the free wedge is of so small an order compared with the depressions in the surface, that the formation of the oil pressure wedge passes over the summits of the elevations. Frictional values change continuously and so seizure does not occur.

W. E. J. B.

355. Performance of Complete Clearance Bearings as Affected by Changes in Load, Speed, Clearance and Lubricant. C. Jakeman and A. Fogg. *Proc.*, 1938, **1**, 138–144.—The performance of complete clearance bearings is determined by the friction loss and the seizing temperature; in this investigation the influence on these factors of speed, load, clearance, and lubricant was examined.

The experiments were carried out on National Physical Laboratory journal-bearing machines in which a bronze bush is loaded by a lever and link system, which also serves to measure the friction torque on the bush. The bearing is heated by means of hot gases, which pass through the hollow journal into a surrounding casing, the temperature being measured by a thermocouple placed in a hole in the upper (loaded) side of the bush within about 0·02 in. of the bearing surface. Oil is pumped to the unloaded side of the bush and is filtered before returning to the sump.

Some difficulty was experienced in securing consistent results, owing to small continuous changes in the bearing surfaces of the bushes, probably due to wear at seizure, compression of the bush material or the presence of a small piece of grit too small to be removed by the filter. The general conclusions, however, were that increase of speed or decrease of load results in increase of seizing temperature, and an increase in viscosity of the lubricant generally has a similar effect. The effect of clearance was masked by the changes in the form of the bushes. With uniformly finished and completely run-in bearings the minimum coefficient of friction would probably be independent of the variables considered, the actual value depending on the quality of surface finish. E. F. C.

356. End Leakage and Oil Circulation of Ring Lubricated Bearings. G. A. Juhlin and R. B. Poole. *Proc.*, 1938, **1**, 145–150.—The existing theoretical equations for the calculation of end leakage with oil-ring bearings are discussed. The results of the experimental determination of end leakage from bearings of this type are given, and the data demonstrate that the existing theories over-estimate the end leakage from journal bearings. It is found that 100% increase in viscosity makes no appreciable change in the end leakage. The authors conclude that any advantages to be expected from increasing the quantity of oil delivered by oil rings would appear to be attributable to improved cooling of the journal by the excess oil supplied, and that, by paying more attention to the distribution of surplus oil, more efficient cooling may be obtained. J. W. H.

357. Oil Supply in Self-contained Bearings. G. B. Karelitz. *Proc.*, 1938, **1**, 151–156.—This paper discusses means of oil supply to the shell of "self-contained" bearings, *i.e.*, those which operate without the assistance of external pumps to feed the lubricant into the bearing clearance.

Following a general consideration of the conditions obtaining in a journal bearing the author deals with the mechanism of operation of the oil ring, and with the functioning and applications of waste packed and starved bearings. E. F. C.

358. Lubrication of Textile Spindles. H. G. King. *Proc.*, 1938, **1**, 157–161.—Textile spindles may be divided into three classes: (*a*) mule, (*b*) flyer or speed, and (*c*) ring spindles. The first two types mentioned need not be considered, as the speeds at which they run do not in themselves lead to any lubricating problems. Ring spindles are generally of the so-called flexible bath-lubricated pattern. The materials used in construction, the method of operation and the lubrication system of this type of ring spindle are described. Spindle speeds of between 10,000 and 12,000 r.p.m. are in common use.

For the lubrication of ring or other bath-lubricated spindles, it is necessary to use an oil of the lightest possible body that will maintain a complete lubricating film with minimum friction and lowest operating temperature. The high speeds and rapid circulation of oil through the fine clearances between spindles and inner tubes make it essential that the oil in use shall have maximum fluidity compatible with effective lubrication and be of such a nature that it will not oxidize readily or form gummy deposits with continued use. Oil of viscosity R.I. at 70° F. of 68 secs. is suitable. Average oil temperatures under mill conditions may reach 80–100° F.

Results of tests carried out to examine both the material and wear of inner tubes

are given. Consideration is given to the most satisfactory design of lubrication systems and recommendations are made regarding clearances. R. A. E.

359. Thrust Bearings : Theory, Experimental Work and Performance. E. A. Kraft. *Proc.*, 1938, **1**, 162–170.—Consideration of the pressure, type of oil and bearing metals to be adopted in design. Pressure bearing capacities are illustrated by reference to experiments carried out by Brown, Boveri Company, and the Allgemeine Electricitäts Gesellschaft, and loads of 30 kg. per sq. cm. for large pads and 20–25 kg. per sq. cm. for small pads are recommended. Several actual designs are given by way of example. P. D.

360. The Tapered-Land Thrust Bearing. F. C. Linn and R. Sheppard. *Proc.*, 1938, **1**, 171–178.—The paper describes features in the design and construction of the tapered-land thrust bearing which, because of its simplicity, ability to withstand high unit loading and lower power loss has come into commercial use with success in a wide variety of applications, notably in turbine installations.

A machine designed for testing thrust bearings at speeds up to 20,000 r.p.m. has enabled valuable experimental work to be carried out, as a result of which a line of thrust bearings has been developed for turbine sets, including marine installations, for speeds varying from 1,500 to 20,000 r.p.m. and ratings ranging from 100 kw. to 160,000 kw. E. F. C.

361. Journal Bearings Design as Related to Maximum Loads, Speeds, and Operating Temperatures. S. A. McKee. *Proc.*, 1938, **1**, 179–186.—The author suggests that especially for heavy-duty, high-speed bearings a rational basis for design would seem to be the determination of the maximum allowable loads and speeds predicated upon two primary considerations, (1) that the bearing shall always operate in the region of stable lubrication and (2) that the operating temperature of the bearing shall never exceed some fixed value.

The author deduces an equation indicating approximately the relation between the rise in temperature of a bearing above its surroundings and the other factors involved when it is operating in the region of stable lubrication. Its application to design may be made directly in the cases of self-cooled bearings and to independently cooled bearings, either by the insertion in the equation of suitable factors relating to the cooling system, or without this modification to indicate a limit beyond which independent cooling is necessary. E. F. C.

362. Some Factors that may Determine the Service Life of Tin-base Bearing Metals. D. J. Macnaughtan. *Proc.*, 1938, **1**, 187–195.—In this paper possible causes of the failure of the white-metal bearings of internal-combustion engines are suggested by consideration of the fatigue stresses imposed.

The temperature of the bearing is found to be one of the most influential factors in determining its life, and one which affects the choice of a tin-base bearing metal of improved fatigue properties. Tests have shown that the addition of cadmium in amounts up to 3% to a tin-base alloy containing antimony and copper increases the fatigue strength at all temperatures up to 150° C.; at higher temperatures the reverse effect is shown, whilst the addition of a small percentage of lead to an alloy containing 1% of cadmium can offset the increase in strength gained by the presence of the latter metal. E. F. C.

363. Tilting-pad Bearings and their Practical Limitations. A. G. M. Michell. *Proc.*, 1938, **1**, 196–203.—The purpose of this paper is to review briefly the development of bearings of the tilting-pad type and to indicate the possibilities of their future improvement and extended application, having regard to their constructional limitations.

The practical limitations of multi-pad bearings, both of the thrust and journal types, assuming equal care is taken in their manufacture as given to other bearings produced in quantity to standard dimensions, arise only from :

(1) Insufficient strength or rigidity in the parts to maintain the theoretical forms with the necessary accuracy ; or,

(2) Inadequate means for removing the heat generated by the shearing of the oil film, and therefore for the maintenance of sufficient viscosity in the oil to prevent metallic contact taking place. E. F. C.

364. Lubrication of Bearings of Internal Combustion Engines. V. Mickelsen. *Proc.*, 1938, **1**, 204–207.—From practical considerations the author reaches the following conclusions regarding oil-film thickness and wear in internal-combustion engine bearings: (1) The more intense but briefly sustained pressures due to combustion are of small importance compared with the less intense but longer sustained pressures due to centrifugal force and inertia. (2) Wear takes place during full speed running and not when starting or stopping. (3) Wear is due to abrasive particles passing through the oil film at its thinnest part.

Calculated oil film thicknesses are given for several engines, ignoring the effects of combustion loading; but it is pointed out that in some of the examples this simplification may not be justified. J. G. W.

365. Copper Alloys as Bearing Materials. D. P. C. Neave and W. B. Sallitt. *Proc.*, 1938, **1**, 208–215.—The traditional use of copper rich bronzes as bearing materials for comparatively high pressures and slow speeds has been based on practical experience, and the recent high additions of lead have extended the use of this material to the high-speed field. The composition, structure, method of working and application of the various copper alloy bearing materials are given. J. M. F.

366. Influence of Pressure on Film Viscosity in Heavily Loaded Bearings. J. S. Needs. *Proc.*, 1938, **1**, 216–222.—Heavily loaded bearings were tested using mineral oil, castor oil and glycerine as lubricants. It is shown that the behaviour of the bearings under increasing loads up to 7000 lb. per sq. in. may be explained by their pressure viscosity characteristics. Some of the differences between oils usually attributed to difference in "oiliness" may be due to the pressure effect. P. D.

367. Instability of Oil Films and More Stable Bearings. B. L. Newkirk. *Proc.*, 1938, **1**, 223–226.—Shafts running on journal bearings at speeds of the order of twice their critical speeds or higher, tend to build up whirling or vibration. This is due to oil-film action, and is most suitably called "oil-film whirl." Factors affecting this whirl and methods of overcoming it are described. J. M. F.

368. Nomy Pad Bearing: Development and Design. F. K. G. Odqvist. *Proc.*, 1938, **1**, 227–233.—The application of the tilting pad to journal bearings has been very limited, as the eccentric support of the pads necessitates the use of one direction of rotation. In the Nomy pad bearing the pads change their point of support when the direction of rotation is reversed. The method of doing this and the construction of the complete bearing are described with diagrams, and further advantages of the bearing are dealt with. J. M. F.

369. Film Lubrication Applied to Railway Axle Bearings. J. F. Petree. *Proc.*, 1938, **1**, 234–240.—The author deduces that for the efficient operation of a railway axle bearing a permanent oil film must be maintained. The factors essential for this are listed, together with other highly desirable features. Several patented types of railway axle bearings are mentioned and the Peyinghaus Axle-box is described. Improvements on the latter have been tested in Germany and at the N.P.L., with results justifying experiment on a wider scale. J. M. F.

370. Re-examination of the Hydrodynamic Theory of Bearing Lubrication. L. Prandtl. *Proc.*, 1938, **1**, 241–248.—A special bearing testing machine was designed and used to test the hydrodynamic theory. Clearance, attitude and pressure distribution over the bearing were measured both for cases in which the condition of a plane pad sliding over a plane bearing and a cylindrical pad over a plane bearing were simulated. When the bearing was fully submerged the hydrodynamic formula was found to be fully correct. When oil was fed to the bearing not submerged

anomalous results were obtained which are attributed to the entrance of an air film into the oil film. P. D.

371. Heavy-Duty Bearings of Phenolic Plastics. H. M. Richardson. *Proc.*, 1938, **1**, 249–259.—The laminated phenolic plastic bearing has been used for all types of rolling mill in which the bearings are water-cooled, the water being used also as the lubricant. The theoretical amount of water required and its method of application for different types are discussed, the effect of water shortage being increased bearing clearance, but the shaft is not scored. The design of the bearings in current use in the U.S.A. and the general design for different types of mills is described, with regard to the special properties of the phenolic materials used.

Four other applications other than rolling mills are suggested, *e.g.*, in the manufacture of cane sugar and in paper-making machinery. The essential features and the properties of the raw materials used are also reviewed. The economies resulting from their use are mainly due to the low coefficient of friction and the elimination of scoring of the roll necks, the low coefficient of friction at high loads giving film lubrication.

The limitations of their use are due to the low heat conductivity and instability to temperatures above 300° F. unless bonded with asbestos. The increased application in the rather limited fields of use is visualized. C. H. S.

372. Fabric Bearings for Rolling Mills. H. Rochester. *Proc.*, 1938, **1**, 260–265.—The use of water-lubricated bearings for rolling-mill work offers the following advantages: (*a*) reduction in friction, with great saving in driving power costs, (*b*) the rolls can be held to gauge setting, giving a reduction of cast out work, (*c*) reduction in maintenance and longer runs without shutdown. Information is given on the loading, lubrication and application of fabric bearings to rolling mills. J. W. H.

373. Lubrication of Laminated Synthetic Resinoid Bearing Materials. H. W. Rowell. *Proc.*, 1938, **1**, 266–268.—Water is not only the most effective lubricant, but also supplies the cooling medium so necessary to this type of bearing at high bearing pressures. Under very heavy loads with oil as a lubricant, the removal of heat can be effected by pump circulation. Graphite lubrication of dry bearings on light load can be quite effective. The incorporation of graphite in the moulding materials cannot offer any advantage over a graphitized surface of a plain material, as the bearing does not wear sufficiently to release any graphite incorporated in it.
J. W. H.

374. Lubrication of Journal Bearings with Water-Base Lubricant. F. Samuelson. *Proc.*, 1938, **1**, 269–276.—In view of the disastrous fires which have occurred in electrical power stations, due to the burning of the lubricating oil used in the turbo-generator system, experiments have been made with a water-base lubricant containing 2% of a water-soluble oil in a 25-kw., 3000-r.p.m. turbine set and in a bearing testing machine operated at various speeds (3000–6000 r.p.m.) and loads (30–170 lbs. per square inch), such as are met with in standard turbine practice. The results of these experiments demonstrated that the water-base lubricant was superior to oil. In the experimental bearing, the frictional losses at 6000 r.p.m. with oil as a lubricant were nearly twice those obtained with the water-base lubricant, and the bearing temperature was 40% higher. J. W. H.

375. Some Applications of Fabric Bearings. E. W. Smyth. *Proc.*, 1938, **1**, 277–284.—Data are given of the savings effected by the replacement of the brass bearing of a large wheel rolling-mill by bearings consisting of a series of strips of laminated fabric resin bonded material set in a phosphor bronze housing. The design of the bearings, and the savings in terms of output, power and maintenance are given.
J. W. H.

376. Bearing Problems of Large Steam Turbines and Generators. C. R. Soderberg. *Proc.*, 1938, **1**, 285–296.—The construction and operating conditions of journal and

thrust bearings for turbines and generators are described and formulæ given for deriving oil-film thickness, coefficients of friction and mechanical loss for both types.

Lubrication is only one function of the oiling system of the modern steam turbine; the other functions are enumerated and the troubles encountered with the oil are described briefly. The problems incidental to high steam temperatures, heating of the oil and fire risks, and the problems of the operation of large, high-temperature turbines, the necessity for turning gear and vibration and similar phenomena are dealt with. J. M. F.

377. Earlier History of the Hydrodynamic Theory of Lubrication Friction. A. Sommerfeld. *Proc.*, 1938, **1**, 297–301.—The course of the present theory is briefly traced from the initial work of Petroff and Reynolds. P. D.

378. Lubrication as Applied to Locomotive Journals. W. A. Stanier. *Proc.*, 1938, **1**, 302–308.—The author deals more particularly with the lubrication of coupled axle bearings, as this is the most complex case; but in all axle boxes the oil must have a higher viscosity than the minimum required for film lubrication whilst running so that the oil film can be re-established quickly on restarting the locomotive.

The small variations in the temperature of axle-box bearings with different speeds, often less than the variation from bearing to bearing, suggest that lubrication is of the viscous film kind.

The merits of the several methods of lubricating the modern axle-box bearing are compared and the mechanical lubricator is judged the best. The results of investigations into the causes of hot bearings showed that a higher quality of oil than that normally used, mainly mineral oil with some refined raw rape oil, would not have been beneficial. J. M. F.

379. Theory and Experiment Applied to Journal Bearing Design. H. W. Swift. *Proc.*, 1938, **1**, 309–316.—Equations are derived from Osborne Reynolds basic equation, combined with certain assumptions, connecting film thickness and friction with the constructional and impressed conditions in journal bearings under steady loading. For the convenience of designers the formulæ are expressed in line chart form; two charts enabling the diameter and diametral clearance to be found for given loads and speeds.

A theoretical examination of certain cases in which the bearing load is subject to cyclic variations suggests that similar methods to those used by the author for steady load conditions might ultimately be applied to such bearings as well. J. M. F.

380. Tests of Bearings: Methods and Results. A. Tenot. *Proc.*, 1938, **1**, 317–322.—The machines used at the French Ecole Nationale des Arts et Métiers for the study of the physics of lubrication and the influence of various factors on bearing design are described. One machine is for testing bearings in general, and consists of a bearing mounted in a swinging frame driven by a motor. The frictional torque is measured by balancing the swinging stator, the load being applied by a six-ton hydraulic press. The other machine is for testing pivot and thrust bearings, and is similar in set up to the other machine, the load being applied in this case by a 60-ton press.

Figures and curves are given for a study of the influence of the viscosity of the oil, speed of rotation and load on a tilting-pad journal-bearing; also a comparison is made between the results obtained and similar tests made by the Isothermos Co. Laboratory. Other curves are given for a tilting-pad footstep-bearing and a needle-bearing.

In conclusion, the author points out that the accuracy of finish of bearings, the influence of the metals used and the preservation of the physical properties of the lubricant are all studied at the Ecole Nationale des Arts et Métiers, and provide valuable cultural discipline. C. H. S.

381. Film and Friction Measurements on Journal Bearings, including Fabric Types. A. S. T. Thomson. *Proc.*, 1938, **1**, 323–329.—From a comparative examination of bronze and fabric bearings in a bearing testing machine, it is concluded that water-

lubricated fabric bearings give lower frictional losses and longer life than bronze bearings under conditions of high loading, such as are met with in rolling-mills.

J. W. H.

382. Tests of Plain Bearings with a New Method of Lubrication under very High Pressure. G. Welter and W. Brasch. *Proc.*, 1938, **1**, 330–335.—Amongst the chief disadvantages of modern plain bearings is the high frictional resistance at starting. This could be overcome by a suitable modification to the supply of lubricant, since improvements could not be expected in the bearing materials so much as in the lubrication, which is still in a backward state.

Tests show that by supplementing the usual lubrication with a high-pressure supply at the region of highest load, lower frictional resistance is produced at starting, together with smoother and cooler running bearings. The use of this system makes it possible to reduce the size of the bearing, or, if the present size is retained, to use alloys previously not good enough for lining brasses. J. M. F.

383. Temperature Rise in Bearings of Automobile Engines and its Influence on Durability. C. G. Williams, M.Sc. *Proc.*, 1938, **1**, 336–342.—The results obtained from a study of the effect of temperature on the wear and durability of white metal (D.T.D. 214), and the factors influencing the temperature rise of main and big end bearings are given.

A special machine consisting of a crankshaft of Ni–Cr steel, with connecting-rod and dummy piston, was used. With this set-up, the rate of wear of the white-metal big end with oils of different viscosities was measured. By altering the weight of the "piston" (no gas compression forces were introduced) it was possible to load the big end as wished. The results obtained with different oils over a range of temperatures are shown graphically, one set of curves for the crankpin, another for the bearing. Below 100° C. the lightest oil gave the lowest wear; with increased temperature up to 150° C. it increased most rapidly, but above this temperature the wear decreased rapidly, due to the formation of a skin of lacquer on the surface. Another curve gives the relation between wear and the operating viscosity of the lubricant. It is found that the wear is not necessarily a function of $\frac{ZN}{P}$ (Z = viscosity in cp., N = r.p.m., P = mean bearing pressure in lbs./sq. in.). The time taken for the white metal to begin to break up is also plotted against temperature, and shows that at higher temperatures fatigue cracking shows after a much shorter working life.

A study of bearing temperatures, using a six-cylinder, two-litre engine, shows that these rise proportionally with higher inlet oil temperatures, a result of importance in connection with the efficacy of oil coolers. The results indicate also that the lubricant is responsible for the removal of a large proportion of the heat, and that an increased rate of flow lowers the bearing temperatures considerably. The last graph shows the effect of oil viscosity on bearing temperatures, and the fact that the lower bearing temperatures are found with lower-viscosity oils, points to the fact that the use of these oils may actually prolong the life of a bearing. C. H. S.

Group II.—Engine Lubrication.

Report on Papers in Group II. Engine Lubrication (Internal-Combustion Engines). H. R. Ricardo. *Proc.*, 1938, **1**, 607–613.

There are more than thirty papers in this group dealing with the lubrication of internal-combustion engines, and several in the other groups which have some bearing on the matter. The most popular problem is that of cylinder bore wear. Fig. 1 of *Yeats's* paper gives wear rates apparently collected from large oil engines in service, and shows a close relationship between the wear and the running period between starts. If the horizontal scale of this diagram is inverted, so as to read "starts per 1000 hours" instead of "hours per start," the original curve becomes roughly a straight line; thus the wear may be expressed as so much per hour run plus so much per start, and the slope of the line shows that each start causes as much wear as about sixteen hours' running. Thus, in the typical case of eight hours' run per day, two-thirds of the wear appears to be due to starting, and only one-third to running. On the other hand, the tests of *Everett* and *Keller* on automobile engines show only a

small starting wear equal perhaps to one hour's running. *Taub* and *Young* do not consider that corrosion is normally the main cause of wear, the former considering it to be the result of blow, and best remedied by the fitting of improved piston rings and by a plentiful oil supply.

As regards cylinder materials, there is a fair measure of agreement, *Ottaway*, *Pearce*, and *Young* all agree on the advantages of pearlitic structure and of high phosphorus content. Several authors also mention the advantages of austenitic iron, at any rate under cold conditions, and of a coarse graphitic structure.

Coming to lubricants, *Williams* shows that there is an appreciable viscosity effect under cold conditions, low viscosity giving high wear. As regards composition, *Bass*, *Bouman*, and *Norlin* agree that "oiliness" dopes have little effect, but *Rosen* shows that anti-oxidation dopes reduce wear considerably.

The value of graphite as a running-in compound is generally admitted, but opinions differ as to its value for normal running. *Higinbotham* quotes evidence in its favour, but *Norlin's* road tests suggest an increase in wear due to its use.

Freeman has found that large additions of new oil to old increase sludging, so that make-up oil should be added gradually. *Flowers* suggests that the fine carbon in used oil has the beneficial effects of colloidal graphite. *Jones* and *Turner* quote figures which show that the large improvement in oxidation resistance, obtained by modern refining methods, is not accompanied by any loss in lubrication quality. *Auld* and *Nicholson* point out the importance of minimizing aeration in the circulating system, particularly in engines with oil-cooled pistons.

There are two schools of thought regarding oil consumption: the American, represented by *Taub*, who advocates a plentiful feed to the cylinder with special high-pressure rings to give drastic scraping; and the European, as represented by *Ottaway* who states that high-pressure rings give no improvement in prolonged running, and that it is still necessary, therefore, to limit the quantity thrown off from the big end.

Bearing materials have had little attention in this group of papers, but in Group I there are two papers, one by *Macnaughtan* dealing with tin-base metals, and the other by *Neave* and *Sallitt* on copper alloys, which form a good review of the situation. For big ends, the crux of the problem is cooling. White-metals lose fatigue strength rapidly with increase of temperature, but if they can be kept cool enough, will generally withstand service conditions. There have recently appeared some improved alloys which are claimed to have better mechanical properties than normal white-metal at high temperatures, and yet to work well on a soft shaft. Synthetic resin has also been suggested as a bearing material, since it has done well in other applications, but the reporter does not know of any case where it has been used in internal-combustion engines. Taylor directs attention to another factor which may contribute to the troubles of heavily loaded bearings—namely, flexure of the parts—and also raises the question of the effect of load variation on carrying capacity. Load reversal is certainly an advantage with low rubbing speeds, as is shown by the well-known fact that the gudgeon pin of a four-stroke engine will withstand far heavier loadings than that of a single-acting two-stroke engine, where there is no reversal. *Mickelsen* makes the bold suggestion that it may be possible to lubricate a crosshead-type engine with water or a water–oil mixture, as in the old Willans steam engine.

With regard to filtration, it is an open question as to whether oil, if properly filtered, can be re-used indefinitely. *Beale* quotes cases of engines in which the oil has not been changed for ten years, though it is probable that oil consumption and replenishment had, by that time, eliminated all but a minute fraction of the original oil. *Young* considers that used oil becomes corrosive, but *Flowers* believes that the increased acidity of used oil is, if anything, beneficial, on account of the oiliness it confers. In any case, this acid can be removed, as *Cahill* and *Dolton* and *Mackegg* point out, by washing with water in a centrifugal separator. *Pickard* gives some interesting figures as to the size of particles passed by various types of filters. Comparing these with the figures for working clearance of bearings given by *Mickelsen*, it appears that, even with filtration, something is left to scratch the bearing surfaces, though the worst offenders are doubtless removed. *De Langen* shows that magnetic filters can remove extremely small particles of iron and can reduce wear. In cases for which the reporter has figures, these ferrous particles average about one-half of the total incombustible matter in used oil, and it would be interesting to know what part they play in the total abrasive effect.

Report on Papers in Group II. Engine Lubrication (Reciprocating Steam Engines). W. A. Stanier. *Proc.*, 1938, **1**, 614–618.

It is to be noticed that the French and German State railways consider that various grades of superheated cylinder oil are desirable according to the degree of superheat obtaining in the cylinder, whereas the Canadian National and English railways employ only one grade. The German State Railways use winter and summer grades of oils for journals, motion, etc., as do certain of the English railways, while the Canadian National and the other English railways prefer the same grade throughout the year. It is the practice of the German State railways to use wick trimmings for supplying the oil to the valve-gear, connecting and coupling rod bushes, while the English railways use worsted trimmings for the valve-gear and either worsted trimmings, needle trimmings or felt pads for the rods. When needle roller bearings are fitted to the valve-gear in this country, grease is used as the lubricant.

On the modern locomotive, the pump lubricator has generally superseded the hydrostatic system for supplying the lubricant to the cylinders, and the general principles employed by the German and French State railways and the English railways would appear to be similar as regards the position of the pump, the provision and position of back-pressure valves, etc. A point of interest is the recommendation by *Chatel* that the high-pressure cylinders should be lubricated towards the dead centres, where the piston is almost stationary, so that the piston rings can receive plenty of oil. Most of the French railways inject steam or water into the cylinder exhaust to reduce the temperature of the gas when coasting.

The analysis and mechanical tests of cast irons for piston rings and cylinders given by *Chatel* correspond to those generally in practice on the English railways, except for the higher percentage of silicon and the lower percentage of phosphorus, which should be noted. The tendency towards the use of a harder metal for the rings than for the cylinders is interesting.

In dealing with marine-engine lubrication practice, *Freeman* expressed general satisfaction as to the way in which the oils have been improved to stand up to the much heavier duty imposed by modern conditions. Superheated steam valves, pistons and liners are lubricated by mechanical lubricators feeding into the steam pipe or round the high-pressure liners.

In their paper on oil-circulation systems, *Auld* and *Nicholson* direct attention to the importance of using oils which are least affected by the joint action of heat and oxidation.

Oil-circulation systems fitted to enclosed steam engines give rise to difficulties peculiar to themselves. Owing to the liability of a small amount of cylinder oil to find its way into the crank chamber, *Auld* and *Nicholson* recommend, on certain types of engines, the collection and examination of oil from the separator to ascertain its suitability for re-use. The authors also consider that aeration in steam turbines and similar systems can be considerably reduced by :—

(*a*) The employment of suitable circulating pumps;
(*b*) the provision of suitable pipe work with gradual bends, etc.;
(*c*) preventing splashing and cascading the oil;
(*d*) by removing unavoidably entrained air quickly.

Stress is laid on the design of the separating tanks, which should be accessible for cleaning and of such shape to facilitate deposition and drainage.

In his paper dealing with the practical problems of lubrication, *Nicholson* emphasizes, with regard to cylinder lubrication, that a small amount of oil of the correct type should be applied in the correct manner to obtain the best results. In the case of air compressors, the necessity of providing a clean air supply and the correct quantity of oil is stressed. As a result of observations over a length of time, Nicholson confirms the laboratory discovery that the addition of a small percentage of free fatty acid increases the effectiveness of a mineral oil when used for all erratic or partial lubrication, such as hand lubricated bearings.

In discussing the lubrication of heated bearings, it is pointed out that the bearings should be designed to give a smooth flow of oil from all parts to the outlet, to prevent the accumulation of any deposits found.

384. Oil Circulation Systems in the Lubrication of Industrial Machinery. S. J. M. Auld and H. J. Nicholson. *Proc.*, 1938, **1**, 389–397.—The problems connected with oil-circulation systems have two main aspects: the provision of an oil of adequate chemical and physical stability, and the design of the system to ensure that any inherent adverse properties of the oil do not lead to inefficient operation.

The authors suggest that designs should be such that the oil is not subjected to undue aeration with consequent oxidation; unduly high temperatures for long periods; or to conditions which would assist emulsification or sludging. On the basis of these points, a critical survey of existing systems with suggestions for improvements is given, and applied individually to steam turbines; enclosed steam engines; and internal combustion engines. J. G. W.

385. Petroleum Engine and its Friction. R. Barrington and J. L. Lutwyche. *Proc.*, 1938, **1**, 398–406.—The authors have investigated the static or breakaway torque which must be overcome in starting an I.C. engine. A four-cylinder engine of 1650 c.c. capacity was used at −1° C., and the contributions made to the final static torques by various engine components—*e.g.*, crankshaft, piston alone, piston plus rings—were investigated.

The highest torque for the complete engine was a little under 15 lbs. ft. The original cranking torque formula put forward has been modified to $T = K\sqrt{NV}$ where T = torque in lbs. ft., N = r.p.m. and V is oil viscosity in centipoises. The constant K is approximately proportional to swept area, and ranges from about 0·05 to 0·3. The formula appears to hold down to very low speeds—*e.g.*, 8 r.p.m.—but the value of K is affected by the addition of oleic acid. For example, an engine which gave a value of K equal to 0·094 with straight mineral oils gave a value of K of 0·07 when 12½% of oleic acid was added to the mineral oil. The increase in the value of K as the engine is assembled has been examined, and it is clear that the pistons contribute the greatest resistance to cranking torque.

The use of the formula for calculating engine resistance curves at high speeds and temperatures is shown, and in a particular engine the calculated results agreed closely with those obtained experimentally.

In considering the starting of an engine from cold it is shown that the "tick-over" speed of an average 2-litre engine is barely sufficient to overcome the internal friction, even when running with a winter oil in the sump (3600 centipoises at − 1° C.).

This subject is further developed in showing that even when the oil is thoroughly hot, *e.g.*, 75° C., a considerable loss in b.h.p. can be attributed to overcoming oil friction.

The paper concludes by advocating the use of thin oils for engine lubrication. W. E. J. B.

386. Alteration of Lubricating Oils during Use in Internal-Combustion Engines. C. H. Barton. *Proc.*, 1938, **1**, 407–413.—Results of the Indiana and Air Ministry oxidation tests are compared, and it is concluded that these tests generally agree in discriminating between oils of high and low resistance to oxidation. Oils possessing different oxidation resistance do not necessarily exhibit different behaviour in test engines. High oil consumption is shown to have a very marked effect in increasing the rate of deterioration of a lubricant, and any steps taken to reduce the oil consumption not only effect a direct saving, but also prolong the useful life of the oil. The experimental data on which the foregoing conclusion is reached were obtained by varying the rate of oil circulation on a single-cylinder bench engine. J. W. H.

387. Aero-Engine Design and Lubrication. E. L. Bass. *Proc.*, 1938, **1**, 414–420.—The problem of lubrication as it affects the design of aircraft engines is stated to be practically confined to the piston and rings. Piston-ring sticking can be caused either by the rapid accumulation of oxidized material in the ring grooves, or by the more gradual accumulation of sludge and carbon; and on account of the importance of maintaining a gas seal and adequate heat dissipation, aircraft-engine oils are judged primarily by their ring-gumming properties. Piston and ring design are discussed in relation to reduction in working temperature to reduce ring-sticking, and it is stated that the adverse effects of detonation and weak mixture strength must not be overlooked.

The design of cylinder barrels to avoid distortion and excessive wear, and the lubrication of the valve stems, auxiliary gear, and bearings are discussed in relation to the oil used, and it is shown that in some cases improvement in one direction leads to worse behaviour in another direction. Co-operation between oil producer and engine manufacture alone can lead to a satisfactory solution of the problems. J. G. W.

388. Oil Reclamation and the Use of Reclaimed Oil. A. Beale. *Proc.*, 1938, **1**, 421–425.—Stream-line filters are compared with other methods for the reclaiming of lubricating oils from internal-combustion engines. It is concluded that pad filters are too difficult to clean, settling systems are too cumbersome and inefficient, chemical cleaning plants are moderately satisfactory but require skilled supervision, and central refining plants do not offer the most economical method of dealing with used oils. Stream-line filtration on centrifugal separation offer the best solution to the problem, and may be operated most efficiently when installed so as to clean continuously a portion of the engine oil in circulation. Stream-line filters remove material too fine to be economically removed by a centrifugal separator. J. W. H.

389. Lubrication of Piston Rings. C. A. Bouman. *Proc.*, 1938, **1**, 426–431.—The conditions of lubrication prevailing between the piston rings and cylinder walls, and the influence of the physical properties of the oil are discussed.

The problem of ring-sticking, and engine operating conditions which accelerate ring-sticking, are examined. Details are given of various types of product formed from the oil or fuel which cause ring-sticking, and of a method of analysis of the deposits according to the solubility of the components oil, lacquer, asphaltenes, carbon, soot, and ash in various solvents.

The question of oil characteristics and the possibility of using dopes are examined. Details of tests on three oils in a gasoline engine are given, with comments on the relation between the chemical properties and the performance of the oil in the engine. J. G. W.

390. Oil Purification. A. G. Cahill. *Proc.*, 1938, **1**, 432–438.—A comparison is made of the various methods used in the purification of oil from lubricating systems. The inefficiency of the settling-tank is emphasized. The inherent limitations of filters are: the flow rate of filtration necessitating a bulky and costly filter; the progressive clogging of the filter causing a decrease in the rate of filtration; and the inability of filters to remove water from oils. Centrifugal separators are the best solution to the problem, as water and solid material are removed; by the addition of water to the oil, prior to centrifuging, the acidity of the oil is reduced. The advantage of the by-pass system over batch filtration is demonstrated. J. W. H.

391. Lubrication of Locomotive Cylinders on the French State Railways. M. Chatel. *Proc.*, 1938, **1**, 439–444.—Details are given of the materials and mode of construction of the piston rings and cylinder liners, and specifications of the lubricating oils used. Mention is made of design details, recommendations, and tests of various features of the lubrication systems, and operating information on such matters as oil consumption and wear. J. G. W.

392. Installation and Operation of Centrifugal Oil Separators. R. H. Dolton and H. Mackegg. *Proc.*, 1938, **1**, 445–450.—The correct lay-out of a continuous centrifugal oil separator installation for a diesel engine is described, with details of the pre-heating required. The special importance of cleaning the oil during running-in on test is stressed.

The application to steam turbines is discussed, with details of the arrangement for best operation; if the oil becomes acid in use, water-washing will be necessary.

Attention is directed to the use of centrifugal machines for cleaning machine-shop oils and paraffin, whereby risk of damage to the machines is avoided, in addition to enabling the oil to be used again. J. G. W.

393. Rating Oils for Cylinder Wear by the Iron Contamination Method. H. A. Everett and G. H. Keller. *Proc.*, 1938, **1**, 451–456.—A method of estimating the rate of

cylinder and piston-ring wear in an engine is described in which samples of the oil were drawn at intervals and examined for iron content. Typical rates of wear diagrams are given, in which the effect of starting up from cold is shown.

The results of some experiments using oils from different sources are given in which definite differences were detected. The authors consider that the results obtained by the method described are of a high order of accuracy. J. G. W.

394. Service Effects of Lubricating Oils. A. E. Flowers. *Proc.*, 1938, **1**, 457–464.—I. Analytical data are given for a lubricating oil used in a 300-h.p. diesel engine, fitted with centrifugal separator working on the by-pass system, over a period of 4000 working hours. From an examination of the oil at frequent intervals it is concluded that the dilution from the fuel or light cracked products reduces the flash point appreciably, and the fire point to a lesser extent; the viscosity is also reduced. Considerably more cracking than oxidation takes place in a diesel lubricating oil, resulting in the production of considerable colloidal carbon, which possesses all the advantages claimed for colloidal graphite. Oxidation produces a slow increase in the organic acidity, which eventually reaches a fluctuating but relatively constant maximum. This acidity is not considered harmful, and in general the tests show that the oil is as good as, if not a better, lubricant than when new. The results of a detailed examination of the sludges are given: 150–200 gm. of oil free sludge per 100 hours of operation are formed; on a new engine this sludge contains up to 75% metal or metallic oxides; later the sediment becomes stabilized, and then contains 5–10% metal or metallic oxides, 20–25% of gummy residues, 70% colloidal carbon and 0·5–2% road dust. The metallic material and road dust are responsible for the wear, and their removal reduces the bearing wear from 0·0001 in. in 10 weeks to a quantity too small to measure.

II. Analytical data are given for a lubricating oil used in two turbine-driven 600-k.w. generating sets, fitted with a centrifugal separator, working over a period of 11,000 hours. From an examination of the oil at frequent intervals it is concluded that the principal reactions in turbine lubricating oil appear to be oxidation, in contrast to diesel lubricating oil, where cracking is the dominant factor. The continuous removal of water by a centrifugal separator not only washes the sludge out of the oil, but also removes the freshly formed acidic bodies; this removal of the acidic bodies may be assisted by the addition of 20% of hot water to the oil before centrifuging. A secondary effect resulting from oxidation and moisture is the production of metallic soaps; these soaps are quite soluble in the oil, and so cannot be separated centrifugally. J. W. H.

395. Influence of Water on the Lubricating Value of a Commercial Motor Oil. A. Fogg and C. Jakeman. *Proc.*, 1938, **1**, 465–470.—The following are the authors' conclusions from the laboratory data obtained on the National Physical Laboratory journal friction machine.

(1) The intimate mixing of 0·01% water with the specially dried oil examined lowers the seizing temperature and increases the minimum friction.

(2) 0·02% or more of water deteriorates the condition of the running surfaces, the deterioration increasing rapidly with increasing water content.

(3) Over the temperature range 20–70° C. the friction curve of the oil is unaffected by water up to 0·05%.

(4) Quantities of water up to 0·05% do not cause any increase in friction as determined in the Dooley testing machine.

In view of these tests, it is recommended that the water content of an oil be kept below 0·02%. J. W. H.

396. Marine Engine Lubrication Practice. S. B. Freeman. *Proc.*, 1938, **1**, 471–479.—The principles of the lubrication of steam reciprocating engines, steam turbines, oil engines, and oil-engine bearings are dealt with separately, including details of the nature of the duty and the corresponding oil requirements.

Conditioning and cleaning of oil are discussed in relation to the reduction of cost and to the beneficial effects of removing sludge and other impurities during service.

Tables are given for the oil supplies to main and auxiliary oil engines; and specifications for the oil for the various duties discussed in the paper. J. G. W.

397. Lubrication under High-temperature Conditions with Reference to the Use of Colloidal Graphite. H. Higinbotham. *Proc.*, 1938, **1**, 480–486.—An examination of the temperature conditions prevailing in various types of steam, petrol, oil, and gas engines is given, from which the author concludes that the oil is often used under conditions very close to the critical maximum temperature, and that in some cases this may even be exceeded. Since colloidal graphite resists oxidation, the author claims that it will sustain lubrication above the critical temperature for the oil alone, but the importance of purity and fineness of the particle size in achieving satisfactory results is emphasized.

The effect of graphite in reducing friction is mentioned, and the nature of the graphoid surface formed when using oils containing colloidal graphite is quoted briefly.

The property of colloidal graphite in increasing the seizing temperature of an oil is given as evidence that colloidal graphite is an effective lubricant for the cylinder zone. The results of engine experiments, which show a reduction in the rate of wear when using colloidal graphite, are given.

The author recommends quantities of colloidal graphite which vary according to the nature of the duty. J. G. W.

398. Lubrication Practice on the Canadian National Railways. S. J. Hungerford. *Proc.*, 1938, **1**, 487–490.—Detailed specifications are given for oils and greases for the lubrication of the various parts of carriages and locomotives; these lubricants must operate efficiently at the extremes of temperature in summer and winter which prevail in Canada. J. G. W.

399. Aero-engine Lubrication and the Performance of Modern Oils. O. T. Jones and E. E. Turner. *Proc.*, 1938, **1**, 491–497.—A summary is given of developments in aircraft engines which have affected lubrication problems, and mention is made of parallel improvements in oil specifications which have been necessary to meet the more exacting operating conditions.

The authors consider that although great improvements have been made in lubricants, credit for the remarkably improved condition of modern engines on stripping after severe bench tests must be given to engine-builders because of the vast amount of research they have conducted on the improved cooling of cylinders, better piston and ring designs, more accurate manufacture, and stiffer designs of connecting-rods, crankshafts, bearing mountings, etc.

In spite of other opinions to the contrary, the authors consider that no sacrifice in lubricating properties has been made in order to obtain the high stability of modern aircraft oils, and give experimental evidence to support their view.

Test values are given for two oils from which a comparison may be drawn between the effects of oxidation in the Air Ministry Test and those actually taking place in an engine.

Future developments and their effect on lubrication are briefly discussed.
J. G. W.

400. Natural and Artificial Ageing of Automobile Engine Oils. E. H. Kadmer. *Proc.*, 1938, **1**, 498–503.—The tests described cover the normal use of various lubricants and fuels in a range of vehicles, and the artificial ageing of heated oil by the action of air and oxygen. Conclusions are reached regarding the effects on oil dilution of fuel type, and summer and winter conditions.

The parts played by the fuel and lubricating oil in the formation of combustible foreign bodies are compared, and the author considers that the fuel is largely responsible. The rate of accumulation of non-combustible foreign bodies is also examined.

Mention is made of wear, and the effect of abrasive introduced with the air intake is stressed.

The ageing effects in an engine are stated to be different from those due to artificial ageing, in that the former can be removed by refining, whereas the latter cannot. The effect of regeneration of the oil in various types of engine is illustrated by tables of experimental data. J. G. W.

401. Application of Magnetic Filters to Lubricating Systems. L. H. de Langen. *Proc.*, 1938, **1**, 504–509.—The continuous removal of iron particles from an oil circulation system can be effected by passing the oil through a powerful magnetic field. Filters of this type have been made possible by the recent advances in magnet steels. The design of magnetic filters is discussed, and data are given of the quantity of iron removed by such filters when fitted to a cinema projector and an automobile engine. Magnetic filters may be constructed to deal with (*a*) the full oil throughput on small machines, (*b*) a by-pass system on larger machines, or (*c*) the oil flow at each lubrication point. J. W. H.

402. Lubrication Systems for Diesel Engines. A. L. Mellanby. *Proc.*, 1938, **1**, 510–517.—This paper is concerned only with the larger size two- and four-stroke diesel engines. The various systems adopted for lubricating the cylinders and bearings are considered separately under these headings. The different methods employed by various manufacturers for introducing oil to the cylinder are described, including the design of the pumps used for this purpose. Various illustrations are given in explaining the systems employed.

The alternative arrangements of oil grooves for bearings are described with diagrams. C. H. S.

403. Practical Lubrication Problems from the Standpoint of a Mechanical Engineer. H. J. Nicholson. *Proc.*, 1938, **1**, 578–524.—(1) *Steam Cylinder Lubrication.*—The various factors to be considered in deciding the type of lubricating system; the cause of, and the methods of avoiding the formation of carbon deposits, are discussed. The relatively small importance attachable to the flash point in these and other respects is emphasized.

(2) *Air Compressors.*—Methods of lubricating machines of this type are reviewed, and it is pointed out that the viscous, high-flash-point oils often specified may be replaced by low-viscosity oils having a lower flash point, which tend to decrease the explosion hazard.

(3) *Gears.*—The correct lubricant required can only be ascertained by experiment on test beds, and the need for attaching a plate, giving lubrication requirements, to gear units is stressed.

(4) *General Machinery.*—Compounded oils are recommended for machinery which is lubricated by means of oil cans, wick and drop oilers, or other erratic means of lubrication, as greasy or boundary conditions of lubrication are frequently present.

(5) *Lubrication of Heated Bearings.*—As an example, steam-heated rollers are considered, and the advantage of a clean bearing-housing design in avoiding deposits is pointed out. An independently driven oil-circulation system is recommended in order to reduce the wear on the necks during the starting periods, and to keep the bearings flushed with cool oil on closing down.

(6) *Diesel Engines.*—In order that the greatest number of brake horse-power hours per pound of fuel may be obtained, the lubricant chosen must be a compromise between low viscosity for economy and high viscosity for safety. J. W. H.

404. Lubrication of Steam Locomotives on the German State Railways. H. Nordmann and J. Robrade. *Proc.*, 1938, **1**, 525–529.—Specifications are given for the oils used in the various mechanical parts of different types of locomotives. Oils meeting certain of these specifications are required to undergo a locomotive test before acceptance for service. J. W. H.

405. Lubrication of Motor-car Engines by Additions to the Carburant. W. Ostwald. *Proc.*, 1938, **1**, 530–537.—Mixture lubrication, or the addition of from 2 to 10% of lubricating oil to the fuel, has proved, according to the author, to be particularly good under the heavy strain of continuous running on the German State motor roads. The conventional method of engine lubrication necessitates the use of special oil coolers to keep down sump temperatures. It is pointed out that V.I., oxidation resistance and other properties which are essential for sump oil, are of no account when mixture lubrication is used.

The author considers mixture lubrication from the point of view of the rubbing

surfaces and the influence of the fuel. As regards the latter, benzole and alcohol are stated to be slightly detrimental to lubrication, but the fuel has a decidedly favourable influence when it contains lead compounds or iron carbonyl.

The author briefly considers upper cylinder lubrication, but points out that it is still doubtful whether upper cylinder lubrication is worth while or not.

In Germany, mixture lubrication is applied exclusively to two-stroke engines. A mixture containing 4% of oil is usual, which for " run-in " engines is often reduced to 2½%. It is stated that such engines practically do not require decarbonization. Pure mineral oils of medium viscosity are advisable. Heavily compounded oils are considered inadvisable.

In conclusion, the author considers there are good prospects for the improvement of the general standing of mixture lubrication. W. E. J. B.

406. Problem of Oil Consumption in High-Speed Internal-Combustion Engines. E. C. Ottaway. *Proc.*, 1938, **1**, 538–545.—A survey is given of the factors which control the initial oil consumption and the rapidity at which it increases during service. Combustion characteristics are considered important, and in the consideration of compression ignition engines, the superiority of the direct type of combustion chamber in regard to oil consumption is demonstrated by experiments on a given mechanical design of engine using three types of combustion chamber. The interrelation of fuel and oil consumption is examined, and it is pointed out that lubricating oil may be burnt in a diesel engine with some degree of efficiency, and may not result in objectionable exhaust smoke.

The general mechanical design and the control of oil splash are discussed; piston and ring design are considered in detail and various recommendations given.

Cylinder, piston, and ring wear are discussed in relation to the maintenance of satisfactory oil consumption. Results of experiments are given which support the author's view that a sufficient phosphorus content is the important item in a cylinder iron of the non-austenitic type. J. G. W.

407. Wear of Cast Iron. J. G. Pearce. *Proc.*, 1938, **1**, 546–549.—The effects of composition, structure and thermal treatment are discussed. A fully pearlitic composition, avoiding hard massive carbide on the one hand and soft ferrite on the other, possesses the greatest wear-resisting properties. When the type of corrosion met with in internal-combustion engines is a problem, an austenitic cast iron is recommended. The thermal treatment of pearlitic irons, resulting in structural changes (*e.g.* pearlite to ferrite, as in annealing), is detrimental to wear resistance. Treatment involving no structural change does not have this effect. The development of nitrogen-hardened cast irons and of chromium-plated irons has made other types of finish available to resist wear. Martensitic iron can be made, but does not wear as well as pearlitic iron. J. W. H.

408. Filtration as an Aid to Lubrication. J. A. Pickard. *Proc.*, 1938, **1**, 550–558.—The probability of a particular particle escaping filtration in a by-pass system is shown mathematically to be extremely small. Various types of filters and their efficiency are reviewed, and it is concluded that edge filters offer the best solution to the problem. Metal edge and composite (metal and paper) edge filters are described, and are shown to be extremely efficient and convenient. A dual filter is described in which the whole of the circulating oil is coarsely filtered and a portion of the oil is finally filtered. The construction enables a fine filter to reach the working temperature rapidly, due to the high rate of oil circulation in the coarse filter, which is situated concentrically with the fine filter. J. W. H.

409. Cylinder Lubrication of Small-Bore Diesel Engines. C. G. A. Rosen. *Proc.*, 1938, **1**, 559–567.—The paper deals more specifically with the influence of carbon and binder forming tendencies on cylinder lubrication.

Cylinder, piston, and piston-ring design are discussed, and the importance of ring-belt temperature is explained. An apparatus is described which will give an indication of the nature and quantity of deposits from an oil under various temperatures, and its use is demonstrated by engine tests. While the author considers that designs to

operate at constant output can be made with little difficulty, he believes that the problem is much complicated when it is necessary to provide for a wide range of load and climatic conditions. On account of this limitation the lubricant must have a minimum tendency to form carbon and binder deposits.

The use of a single-cylinder engine test for ring-sticking in which the sticking is indicated by crank-case blow-by is described. Substantial differences between oils from various sources and with different degrees of refining were observed. The improvements in ring-sticking, sludging, and cylinder wear effected by the addition of small quantities of " dopes " are discussed. J. G. W.

410. Lubrication and Lubricants, as Applied to Locomotive Reciprocating Steam Engines. W. A. Stanier. *Proc.*, 1938, **1**, 568–571.—The mechanical and hydrostatic lubrication systems in use on railway locomotives are described. The author states that " boundary film " or, at most, " greasy film " is the type of lubrication present in steam cylinders. In saturated steam cylinders a pure mineral oil is used, and for superheated steam cylinders a mineral oil containing 5% of fatty oil is employed. The general properties which such oils should possess are given. Since steam cylinder oils are not exposed to an oxidizing atmosphere, it is not usual to examine oils with regard to their tendency to oxidize. Coking tests are not made, as any carbonaceous deposits which form in the cylinders have been shown to be due to the vacuum produced, during coasting, drawing hot gases and foreign matter into the cylinder through the smoke-box. This difficulty has now been overcome by admitting a breath of steam to the cylinder when coasting. J. W. H.

411. Engine Lubrication. A. Taub. *Proc.*, 1938, **1**, 572–576.—The author concludes from his experience that bore wear must be met by the following considerations: (1) A copious supply of oil to the bores as quickly as possible after the engine has been started. (2) Adequate blow-by and oil control at the piston rings not at the oil supply. (3) Temperature regulation by thermostat. (4) Adequate ventilation of the crank-case.

The progress of piston-ring manufacturing methods in Europe and the U.S.A. are compared, and it is shown how in the latter country the development has led to the individually cast ring with high radial tension; the radial tension is not uniform, but has a definite pattern that is calibrated to give the highest resistance to chatter and minimum blow-by.

Oil control and the design of piston and scraper rings are discussed. J. G. W.

412. Problems in the Field of Internal-Combustion Lubrication. C. F. Taylor. *Proc.*, 1938, **1**, 577–582.—Evidence is given that pistons and piston rings operate under partial-film conditions of lubrication, although at high speeds there may be a transition to complete-film lubrication. Data are supplied of the effect of viscosity on the friction under various motoring conditions, and the relationship between speed and oil consumption for a radial aircraft engine. Some of the more important problems of lubrication into which research is required are discussed. J. W. H.

413. Lubrication Practice in Denmark. T. C. Thomsen. *Proc.*, 1938, **1**, 583–587.—The characteristics of lubricating oils are briefly reviewed in relation to service requirements. Lubricants for the following duties are examined: various types of steam and internal-combustion engines, compressors, air engines, refrigerating machines, ball and roller bearings, and textile machinery. J. W. H.

414. Oil Viscosity in Relation to Cylinder Wear. C. G. Williams. *Proc.*, 1938, **1**, 588–594.—Engine tests are described which were made to ascertain the relative rates of wear obtained when using four oils of different viscosity under hot-running conditions, under intermittent operation, and under continuous cold-running conditions. These experiments showed that no substantial differences were obtained under hot-running conditions, but that under intermittent or continuous cold-running conditions, the higher-viscosity oils gave the lower rates of wear. From this it is inferred that viscosity affects the thickness of the oil film giving protection against corrosion.

Experiments are described which measure electrically the time taken from the moment of starting up for a complete oil film to be established on the cylinder walls. As was expected, the lower-viscosity oils showed considerable advantages in this respect, which may offset to some extent their lower corrosion resistance.

J. G. W.

415. Lubrication of Stationary Oil Engines. A. C. Yeates. *Proc.*, 1938, **1**, 595–598.—The degree of finish of the liner surface does not have any effect on the lubricating-oil consumption. It is, however, becoming increasingly evident that liners left with a tool finish are less prone to piston seizure, and are not sensitive to varying grades of lubricating oil. Pressure-ring form has little effect on the lubricating-oil consumption, but ring clearance is an important factor. For low- and medium-speed engines the most satisfactory method of feeding oil to the cylinders is by means of controlled mechanical lubricators. The fitting of efficient wiper rings is essential, if the lubricating-oil consumption is to be kept low. The greatest factor in cylinder liner wear is the number of hours run per start, and the data supplied show that above 100–150 hours run per start the change in the rate of liner wear is negligible whilst below 50 hours run per start a very rapid increase in the rate of liner wear takes place. For moderate- and low-speed engines the lubrication of the main and small end bearings by gravity feed is preferred to pressure feed, as the latter method tends to result in high lubricating oil consumption. J. W. H.

416. Wear of Cylinders and Piston Rings. H. J. Young. *Proc.*, 1938, **1**, 599–606.—A summary is given of the design details and operating conditions which lead to high rates of wear. The conclusions of various observers are collected and given under the various sections into which the subject is divided.

The author considers that much can be done to get oil to the top of ring travel, but that for this to be successful improved metals for the barrels are also required, which have the power to resist abrasive action and the corrosive action of the oil and gases.

Skin fatigue, the author believes, is the cause of the start of wear; this fatigue is induced not only by scoring during the dry or semi-dry moments of contact, but also by etching attack, heating and cooling stresses, and stresses left by machine-shop finishes. J. G. W.

Group III.—Industrial Applications.

Report on Papers in Group III. Industrial Applications. S. J. M. Auld and E. A. Evans. *Proc.*, 1938, **2**, 167–175.

The range of employment of consistent greases has considerably increased during recent years, the reasons being that by virtue of its solidity, grease for many purposes has a big advantage over oil, and modern methods of manufacture can ensure efficient and standard products. *Catterall* and *Maitland's* survey is important because it shows this trend clearly. In various parts of the world, for example, large rolling-mills are being erected in which very elaborate systems of grease lubrication are being incorporated. Grease may be delivered continuously and regularly by means of mechanical lubricators to points 1000 ft. distant.

Anti-friction bearings also are calling more and more for various and suitable greases. These friction bearings are made very accurately, and whatever upsets their accuracy and finish militates against their advantages. Rusting must be prevented, and anything which may cause abrasion kept out. The simplest way to effect this exclusion is to fill the bearing and a suitable part of the housing with grease.

Allied to grease lubrication is the application of viscous emulsions. These emulsions resemble greases in some respects, but differ essentially from them in their larger water content. In the cold drawing of steel tubes, where it is necessary to lubricate the die and the mandrel, neither grease nor a soluble oil is suitable, but a soda-base type of grease emulsified with water is proving satisfactory. The development of improved pressing steels and the increase in the speed of press operations have increased the necessity for improved drawing lubricants. The condition of lubrication during cold pressing is one in which an extremely thin film of lubricant is operating.

Arrowsmith believes that film strength is the most important property of a drawing

compound. To achieve this, resort has been made to solid lubricants, such as talc. More recently, chlorinated and sulphurized oils are being tried. Whilst viscous emulsions were an improvement upon the old compound oil-plus-soap-plus-water mixtures, they have not been found good enough, and their place has been taken by soluble oils which are readily mixed with water to give stable emulsions. Water-soluble oil emulsions are used for rough cutting where tool wear is not important. *Boston* has studied the performance of cutting fluids, and their particular applications to specific metals, tools, and cutting operations. He summarizes under thirteen headings those properties which he considers essential. Then he proceeds to examine the influence of cutting fluids on the torque of a twist drill in various metals. *Lloyd* and *Beeny* state that aluminium alloys are usually machined dry, but *Boston's* results seem to indicate that some advantages are obtained by wet machining. *Miller* states that with the exception of magnesium alloys, some kind of cutting fluid should always be used.

It was not until the introduction of the Hypoid gear that a serious study of sulphurized oils was undertaken. Since that time sulphurized oils for high-duty work have become an integral part of the machine-shop. The Hypoid gear, however, is not the only form of transmission which may require extreme pressure lubricants: many motor vehicles are using them to enable greater loads to be carried by a mere change of the lubricant.

Evans has presented a survey of the relative film rupture strengths of a number of oils and greases, and has recorded some of his investigations on pure organic compounds.

The major factor which has led meter engineers to seek a suitable lubricant has been the production of ferric oxide from the steel pivot in the jewel cup. This oxide is highly abrasive, so the lubricant used must be capable of holding it in suspension.

Merritt's paper is a storehouse of information, and must be read in its entirety to appreciate its value. Reference must be made to his gear-lubricant-testing machine, which has some points in common with the S.A.E. machine.

Passing from power transmission by gears, we come to chains. Chains may be divided broadly into two classes: (1) chains for conveying materials; (2) chains for the transmission of power. *Coulson* restricts his remarks to the latter class. The conditions under which the joints of a chain operate are not so severe as might be anticipated. During the transit of the chain the motion of the bearings is intermittent, so that there is ample opportunity for the fluid lubricant to enter the clearances between the roller and the inner plates. So long as the fluid lubricant does not form sticky deposits, any oil having a viscosity of 600–900 seconds Redwood at 70° F. can be used, but mineral oils are preferred. Grease is not recommended, because of the difficulty of inserting it between the moving parts. On the rear transmission chains of motor cycles and similar exposed drives, however, where it is impracticable to arrange for continuous lubrication by means of oil, grease is used. It must be of the mineral jelly type, so that it can be melted to penetrate.

To mining engineers the papers on Rock-drill Lubrication and Wire Ropes will be welcome. The rapid progress in mining on the Witwatersrand, and elsewhere, owes much to the improved efficiency and construction of pneumatic hammer drills. A modern pneumatic hammer drill strikes from 1700 to 2000 blows per minute. Such a high-speed machine presents certain lubrication difficulties, which are recorded in *Gimkey's* paper. These difficulties have been surmounted by introducing the lubricant into the machine together with the compressed air, by means of an air-line lubricator which should atomize the oil. *Nixon* and *Jackson* tell us that the lubrication of wire ropes for winding purposes presents a somewhat different problem from ordinary lubrication. *Hogan*, of the Safety-in-Mines Research Board, gives a comprehensive survey of the subject, and states that wire-rope lubricants have to work under difficult conditions. The lubricant has to perform two essential functions. First, it must reduce internal friction between the wires and external friction against the drum and pulleys; secondly, it must preserve the metal from corrosion.

Of the three classes of textile spindles—namely (*a*) mule, (*b*) flyer or speed, (*c*) ring—only the ring need be considered, because the speeds at which the others run do not in themselves lead to any lubricating problem. Ring spindles rotate at 10,000–12,000 revolutions per minute, at which speed they can easily be thrown out of balance and caused to vibrate, unless proper precautions are taken. As fluid drag at these high speeds would be most unwelcome, an oil of the lowest viscosity that will maintain a complete lubricating film with minimum friction and lowest operating temperatures is used. Oils having a viscosity of 65–70 seconds (Redwood) at 70° F. are recommended.

The result of the investigation of wear seems to indicate that the best conditions are obtained with cast iron containing 0·50% combined carbon with a network of phosphide eutectic.

417. Lubrication in the Cold Pressing of Sheet Steel. J. C. Arrowsmith. *Proc.*, 1938, **2**, 1–6.—The development of improved pressing steels and the increase in the speed of press operations have increased the necessity for improved drawing lubricants, the simple lubricants such as mineral, vegetable and animal oils being often inadequate under these conditions of use. In addition to high working pressures, another factor tending to bring about metal-to-metal contact is the roughness of finish on the dies, and the conditions of lubrication is thus one in which an extremely thin film of lubricant is operating, *i.e.*, Boundary conditions.

To meet these conditions it has become general practice to make use of compounded lubricants or "drawing compounds" possessing the following properties :—

1. *Film strength*, obtained by the use of tallow, wool grease, lard oil or castor oil, preferably in the form of soaps. Chlorinated or sulphurized oils also confer this property on a compound, whilst the incorporation of a fine powder, such as chalk, talc or flake graphite, is often an advantage.
2. *Slipperiness*. Too much may be undesirable. Flake graphite is useful for increasing this property.
3. *Ease of spreading*, which assists the application of the compound, whether this is effected by rollers or by brushing. The commonly used emulsion type is very satisfactory in this respect.
4. *Ease of Removal*. Since most steel pressings are painted, the drawing compound must be removed. Flake graphite is to be avoided from this point of view. Alkali washes suffice for emulsion-type compounds, whilst trichloroethylene degreasers remove uncombined oils quite easily. Where electric resistance welding is to be used, fillers should be avoided.
5. *Non-corrosiveness*. Sulphurized and chlorinated oils may be distinctly corrosive, and must be removed from the metal as soon as possible.
6. *Heat Resistance*. High temperatures may be set up momentarily and solid fillers are often added to improve the resistance to heat of the compound.
7. *Stability*. Any separation or deposition renders the compound unsatisfactory.
8. *Freedom from Objectionable Physiological effect*. The addition of antiseptics is recommended.
9. *Economy* considered from the point of view of efficiency and price.

The best drawing compounds are necessarily in the nature of a compromise, and the most popular types for automobile body-parts consist of equal parts of fatty oil (free and combined as soap), chalk powder and water. These may be used with the addition of flake graphite, mineral oil or water.

There is at present no laboratory test for evaluating these compounds, and their values must therefore be judged by their performance as lubricants. D. L. S.

418. Steam-Turbine Lubrication Systems and Fire Risk. S. F. Barclay. *Proc.*, 1938, **2**, 7–13.—Tests made with a typical turbine lubricating oil show that ignition is certain with steam pipe temperatures of 600° F. or higher, whilst it is possible down to a minimum temperature of about 560° F. Such figures are materially influenced by the volume of oil used, by the manner in which it falls on to the steam pipe and by the ambient temperature. The steam temperatures employed in the modern power-station are in excess of the ignition temperature of the lubricating oil. Any effective scheme of fire protection embraces (1) minimization of fire outbreak, (2) localization of the fire zone and (3) provision of fire-extinguishing apparatus. The piping of the lubricating-oil system should be isolated as far as possible from the steam-piping. The welded joint is preferable to a threaded connection : pipes should be robust, but with sufficient flexibility to prevent expansion troubles. The practice of encasing the oil pipes in outer protecting pipes should be more widely adopted. As a precautionary measure, to localize outbreak of fire, the provision of dwarf walls on the basement floor around the turbine foundations to restrict the flow of escaping oil is recommended. Any effective fire-extinguishing equipment should be of the fixed installation type with remote control. B. M. H. T.

419. Surface Temperature Flashes on Gear-teeth under Extreme-pressure Lubricating Conditions. H. Blok. *Proc.*, 1938, **2**, 14–20.—The temperatures occurring at the surface of contact of the teeth of highly loaded gears are often very high, and are of great importance for wear and seizure.

During meshing each tooth will show a temperature "flash" due to frictional heat developed in the surface of contact moving over the tooth-face. This paper describes a method for the measurement of these temperature flashes and of checking the accuracy of a previous calculation.

The temperatures were measured by a thermo-electric method, the gear-wheels being made of steels of different composition to give a sufficiently high thermo-electric force. For simplicity spur gears were investigated, and a new design was developed using a planetary construction in which two narrow sun wheels remained stationary, whilst a wide satellite meshing with both revolved around them.

A description of the testing machine is given, and is illustrated by diagrams, whilst details of the method and test conditions are also included.

It has been calculated that the time average of the mean temperature flashes θ is equal to $C_t f \sqrt[4]{P_t^2 n^2}$, where C_t is a constant characteristic for the gear transmission considered, P_t is the total circumferential load in kgms./cm. of face width, n is the number of revolutions and f is the coefficient of sliding friction.

The measured mean temperature rise on the tooth-flanks of two of the meshing-wheels has been plotted against $f\sqrt[4]{P_t^2}$, and the graph indicates that there is a proportional relationship between θ and $f\sqrt[4]{P_t^2}$. Further tests are to be carried out to ascertain whether the relationship between θ and n holds good.

As a rough estimate the highest temperature flash occurring on the teeth will be two or three times larger than the measured average of the flashes, so that at the highest load the highest temperature will be about 200–250° C., the mean temperature level of the body of the teeth being about 75° C. D. L. S.

420. Cutting Fluids. O. W. Boston. *Proc.*, 1938, **2**, 21–27.—Cutting fluids comprise solids, liquids and gases which are applied to the tool point to facilitate cutting operations.

Properties to be desired in such fluids may be summarized as follows: (1) high thermal conductivity, (2) good lubricating properties, (3) high flash point, (4) no separation of solids at ordinary working temperatures, (5) stability, *i.e.* resistance to oxidation and rancidity, (6) no unpleasant odour, (7) not injurious to the skin of the operator or to bearings of machine, (8) non-corrosive, (9) transparent enough for cutting action of the tool to be observed, (10) low viscosity, (11) low price and easily obtainable.

Four main types of fluids are used: (*a*) air blast or suction, (*b*) plain water or aqueous solutions, (*c*) soluble oils—emulsions of mineral oil, animal or vegetable oil plus an emulsifier, (*d*) oils, including straight oils, sulphurized and chlorinated oils.

The performance of these fluids under different conditions is discussed, and it is shown that the effect of a cutting fluid on a given metal is not a criterion of its comparable performance on another material. In the sawing of a metal bar, sulphurized oils ranked first, whilst when turning an annealed 3·5% nickel steel, borax water gave the best performance.

The temperature developed at the tool point while turning various metals varies almost directly with the speed for a given cutting condition. When a cutting fluid is applied in turning steel, however, dry cutting gives the highest, oil somewhat lower and water the lowest temperature. However, oil as a result of its good lubricating properties probably reduces the heat generated at the tool point, and may keep it at a lower temperature than when the better refrigerant is used. D. L. S.

421. Modern Problems in Grease Lubrication. H. G. Catterall and J. Maitland. *Proc.*, 1938, **2**, 28–33.—The methods of applying grease to machinery have undergone some change, and to-day various appliances are used which, while tending towards cleanliness, economy, etc., present various problems in themselves.

1. *Grease Nipples.*—There is a lack of standardization in these, so that various guns and fittings must be used. The hand grease gun operates at about 5000 lb./sq. in., and forces grease past a ball-valve through fine clearances. This results in a tendency for the grease to separate into oil and soap.

Grease-gun application often necessitates the provision of a lubricant to suit the method of application, rather than the lubrication of the bearing, and greases softer than normal have to be used.

2. *Spring Pressure Grease-cups.*—These, again, tend to cause separation of greases. Many of them are wrongly designed.

3. *Application to Ball- and Roller-Bearings.*—Some of these can be lubricated only through nipples, and in consequence may be filled too full, resulting in churning with rise in temperature.

4. *Mechanical Grease Lubrication.*—This has been advocated because of (*a*) regularity of feed, (*b*) reduction in consumption, (*c*) reliability, and (*d*) increased bearing life. This method of applying grease is very satisfactory with a well-designed unit.

5. *Lubrication of Rolling-Mills by Mechanical Lubrication.*—The normal greases for this purpose are generally in block form and contain mineral pitch. They cannot be dealt with by any mechanical lubricator. Thus a softer grease must be used if this method of application is desired. An improvement in these systems to enable them to deliver more appropriate greases is necessary.

If cooling water in sufficient quantity is applied to the roll necks a lime base-grease can generally be found which will give satisfactory service.

6. *Sheet-Mill Lubrication.*—Roll-neck temperatures of 350–600° F. are frequent and lubrication is usually carried out by applying grease-blocks to the necks. The grease is collected after use, re-boiled and blended with new grease. It is essential that a lubricant with low carbonizing tendency be used.

7. *Cold Drawing of Steel Tubes.*—Types of soda grease are available the water emulsions of which give suitable tube drawing compounds.

8. *Grease Specifications.*—The authors are of the opinion that too slavish a regard for a specification is often not in the best interests of either the manufacturer or the buyer. D. L. S.

422. Characteristics of Gear Lubricants Revealed by the Four Ball Extreme-pressure Lubricant-Testing Apparatus. D. Clayton. *Proc.*, 1938, **2**, 34–42.—The apparatus used was that of Boerlage and supplied by N. V. de Bataafsche Petroleum Maatschappij. The oils examined included mineral oils, oils containing zinc oxide, castor oil and extreme pressure lubricants. The criteria observed were mean diameters of the impressions on the balls, the time to seizure and the coefficient of friction at various stages in the test; the first two were plotted against load. Where seizure did not occur the impressions on the clamped balls were closely equal in diameter to the values calculated by the Hertz formula. Seizing time/load, diameter of impression/load, and friction/time diagrams are submitted with photographs of typical impressions.

The results indicate that the lubricants examined may be placed in the following order of increasing merit, according to breakdown load and wear to seizure: ordinary mineral oils, oils containing zinc oxide and castor oil and E.P. lubricants. The time to recovery from seizure, which is probably related to wear, is long with ordinary mineral oils (20–60 secs.), intermediate with castor oil and oils containing ZnO (3–6 secs.) and very short for E.P. oils (1–2 secs.). There is some overlapping, one E.P. oil having a breakdown load no higher than that of castor oil, and a moderately refined mineral oil a breakdown load and wear characteristics of a similar order to that of castor oil. H. G.

423. Practical Considerations of Lubrication and Lubricants in Regard to Anti-friction Bearings. T. W. Cooper. *Proc.*, 1938, **2**, 43–49.—The lubrication of ball-and-roller bearings with oils and with greases is discussed. For service at normal temperatures and high or medium speeds an oil should be of viscosity 300 secs. Redwood at 70° F. At operating temperatures in the range 140–220° F. an oil of viscosity 1500 secs. Redwood at 70° F. is suitable, whilst at temperatures over 220° F. a steam-cylinder oil is preferred. The behaviour of grease in service is largely a matter of its texture. Lime-soap base greases should be of low to medium consistency, with short fibre and a melting point in the range 200–220° F. They are suitable for normal speeds and continuous operation at 100–110° F. Soda-soap greases fall into two classes, one intended for high speeds and the other for high-temperature service. The method

of applying grease is discussed, and sundry precautions which should be observed are noted. The testing of the lubricants is dealt with briefly. H. G.

424. Lubrication of Chains with Particular Reference to Transmission Chains of the Roller Type. R. Coulson. *Proc.*, 1938, **2**, 50–54.—Roller chains consist of a number of plain bearings which must be efficiently lubricated. Since oil can reach the bearing surfaces only by penetration past the ends of the rollers, an oil of medium viscosity is desirable. The oil should be delivered to the inner surface and directed on to the edges of the plates. Chains should, wherever possible, be enclosed to exclude dirt and to conserve oil. Properly designed chains, correctly erected and efficiently lubricated, have a transmission efficiency of not less than 98%. H. G.

425. Extreme Pressure Lubricants. E. A. Evans. *Proc.*, 1938, **2**, 55–59.—The results of the examination of a number of different lubricants and the effect of sundry addition agents on film-rupture strength are reviewed. All the work was carried out on the Almen Testing Machine. Practically all straight mineral oils, irrespective of viscosity, had film rupture strengths of 4000–5000 lbs. per sq. in. Fatty oils showed marked differences. Of those examined, sperm oil had the lowest film rupture strength—8000 lbs. per sq. in.—and rape oil and wool wax the highest—each 15,000 lbs. per sq. in. In general, the film strength of lime-soap greases varies with soap content between 4000 and 15,000 lbs. per sq. in. All sodium soap greases had a film rupture strength of 3000–5000 lbs. per sq. in. Of the metallic soaps examined, chromium oleate was the most efficient in increasing film-rupture strength. Organic esters gave widely different results according to their nature when added in 3% concentration to mineral oil. Of the sulphur bodies examined di(3-carbomethoxy-4-hydroxyphenyl) thioether was very efficient with the added advantage that at 100° C., no visible corrosion was produced on steel, and only a negligible amount on copper. Maximum stresses in hypoid gears continue to increase, and the need for high film rupture strength is at present being met by a reversion to the use of sulphur and lead naphthenate dissolved in suitable oil. H. G.

426. Rock-Drill Lubrication and Performance. S. F. Gimkey. *Proc.*, 1938, **2**, 60–67.—Modern pneumatic drills, having plate or sleeve valves instead of piston valves, are traversed by a stream of high-pressure water. The consequent difficulties of lubrication are aggravated by the tendency of oil to blow out through the exhaust valves. Although in use, intermittent hand lubrication is unsatisfactory.

Best results have been obtained by introducing the oil into the compressed air-line by means of an atomizing lubricator. Laboratory tests and trials have indicated the following specification for oil used in this way :—

Spec. grav.	0·94 (approx.)
Viscosity Red. at 70° F. . . .	2780 secs. ,,
,, ,, 140° F. . . .	240 ,, ,,
Setting Point	Below 0° F.

An improved type of air-line lubricator is described which ensures uniform feed under all running conditions. P. G. H.

427. Lubrication in Wire Drawing. R. Goodacre. *Proc.*, 1938, **2**, 68–75.—Even under the best conditions the energy loss in the die is very large (90% upwards). Only boundary lubrication is operative.

In the *dry drawing* of steel wire the metal rod is first coated with CaOH, dry sodium soap being used as the lubricant during drawing. Frictional forces then act between the die and the lime-hydroxide coating, and not directly on the steel rod. Difficulties which are met in drawing stainless steels and other high chromium alloys are attributed to the presence of adsorbed oxygen or to a passive layer on the metal; the surface is thus saturated and adsorption of lubricant cannot occur. Other soaps (Pb, Al, etc.) have no advantages over the usual sodium soaps.

The mechanism of dry drawing is still obscure. Since soap gives a constant lubricating effect at all temperatures below 150° C., the friction shows no temperature coefficient. It is doubtful, therefore, whether there is much adsorption effect.

In *wet drawing* of steel, which has not been much studied, the rod is coated with a very thin layer of tin or copper which reduces primary friction between die and metal. Other coating metals (*e.g.*, lead) have been tried with some success. The bath is strongly acid (H_2SO_4), and must contain emulsified fatty lubricant (tallow or wax). The latter must consist of very fine particles, and if normal type of soap emulsifier is used, stabilizers (starch or gelatine) must be included. Stabilizers are unnecessary if sulphonated fatty acid emulsifiers are used.

Graphite lubricants are useful in special cases, but on the whole have given disappointing results.

Author suggests that many lubricants, if used at 100–120° C., could give results equal to those with soaps in dry drawing. P. G. H.

428. Experimental Study of Ball and Roller Bearings. Ch. Hanocq. *Proc.*, 1938, **2**, 76–80.—Work by the Société Générale Isothermos, Paris, has shown that under comparable conditions a roller bearing ran so hot that the test had to be stopped, whilst a plain bearing reached a relatively low constant temperature. The author states that these apparently unexpected results have been confirmed by himself. Experiments with ball bearings have shown that the friction is in straight-line relationship to revolutions per minute. This result is justified mathematically. An equation, involving specific pressure, is derived, enabling the friction of ball-bearings to be calculated. P. G. H.

429. Lubrication of Wire Ropes. M. A. Hogan. *Proc.*, 1938, **2**, 81–85.—In flexible wire ropes, moving over pulleys or drums, the strands slide one on another and must be lubricated. The lubricant is applied to the inner core of the rope during manufacture, and has to be replenished during service. In stranded ropes (with fibre core) impregnation of the core with grease or heavy mineral oil is effected under vacuum and pressure. Two-phase lubricants (*e.g.*, oil and wax) are unsatisfactory, because the oil is squeezed out in service, leaving only wax.

Lubricant is applied externally during service by brushing, immersion or spraying. Continuous lubrication using very thin mineral oils is being tried with apparent success.

In general, petroleum oils, either alone or in admixture, are most favoured for wire ropes, and may vary from very thin oils to the heavy oils or greases used in actual manufacture. Attempts to increase the adhesive power by addition of petroleum distillation residues or asphalt have not been entirely successful. Thickening by soap is the best procedure.

In colliery winding ropes the best results have been obtained by using graphite greases for internal lubrication. P. G. H.

430. Cutting Fluids and Cooling Oils in Machine Tools. A. H. Lloyd and H. H. Beeny. *Proc.*, 1938, **2**, 86–91.—Cutting fluids may be plain oils, or they may be water-soluble oil emulsions or "suds." When machining steels, Monel metals and certain copper alloys, a continuous chip is formed which presses heavily on the face of the tool. In such cases, when using high-speed tools, a cutting fluid is very desirable. For rough machinery or high-speed cutting with simple types of tools, soluble oil emulsions giving good cooling properties are usually selected. In forming, hobbing, threading and gear cutting, expensive form tools are frequently used, so that it becomes important to preserve the edge of the cutting tool, and straight oils are chosen, the cost and quality of the oil increasing according to the demands of the operation and requirements for economical production.

Mineral oil is cheap, stable to oxidation or gumming under the influence of cutting heat when exposed to the atmosphere, and causes no corrosion. It lacks a lubricating quality suitable for the extremely severe conditions obtaining in metal cutting, and is not therefore to be advised for use alone. Fatty oils, either of animal or vegetable origin, greatly improve the lubricating quality, but are expensive and tend to deteriorate in use. A compromise is reached by blending mineral with fatty oil. The proportion of fatty oil, which in the best types is usually lard or neatsfoot oil, may vary between 5% up to 50%. Lubricants of the extreme pressure type should be useful, and sulphurized or chlorinated fatty and mineral oils have been tried. Sulphur bearing oils are finding an increasing use. In compounded mineral oils the sulphur is usually

present in chemical combination with the fatty ingredient. However, recently a colloidal sulphur has been produced in the form of a concentrated liquid, which, when added to mineral oil, gives a greater increase in life on hobbing operations.

The chief point in examining cutting oil is the amount and nature of the neutral fatty oil; free fatty acid content should be limited to about 3%; a comparative heating test at 200° C. gives an idea of gumming propensity and loss by evaporation during machining; closed flash should not be less than 350° F.; for a given fatty oil content the oil should be as fluid as possible.

Cutting oils should be cleaned periodically by heating to 140° F., to assist sedimentation and destruction of bacteria, and then centrifuged to remove dirt and metal particles. An effective sterilizing disinfectant is now available.

Soluble oils usually consist of mineral oil blended with fatty oil partly saponified with soda to form a soap. Stabilizers and disinfectants are often added. In many cases the soap is partly replaced by sulphonated oils which withstand greater dilution, and this cheapens cost. The disadvantage of soluble oil emulsions is that they may cause much damage by rusting. It is therefore generally advisable to limit the free fatty acid content of the neat oil to 0·75%.

Recently an improved quality of soluble oil has been developed, giving a clear and slightly alkaline liquid when mixed with water, and possessing greatly improved stability and decreased tendency to cause corrosion even at dilutions greater than formerly used. It has been used exclusively for 15 months at a dilution of 40 to 1, and has shown a great economy. A test for corrosive qualities of soluble oils is described. R. A. E.

431. Lubrication of Gear Teeth. H. E. Merritt. *Proc.*, 1938, **2**, 92–103.—Gear failures may be classified mainly as (1) direct breakage of the tooth proper, and (2) tooth surface failures.

Apart from mechanical defects, direct breakage may result from excessive temperature, due either to imperfect surface lubrication and excessive friction, or to inadequate cooling. Such failures are associated with worm-gears. Typical forms of tooth surface failure are "smooth abrasion," "scuffing," "ridging or dragging" and pitting. The causes of these failures are discussed.

Gear lubricants should properly be selected having regard to their primary function of a protective friction-reducing film between the teeth under the prevailing conditions of tooth surface pressure, speed and gear material; the choice of method by which lubricant is applied to the teeth will then be guided by considerations of gear disposition, speed and viscosity. The precise behaviour of the oil film which separates the gear teeth is not clearly understood. It is probable that a boundary film exists between the surfaces over the areas which would make contact under static conditions, and that this is reinforced by a hydrodynamic film induced by surface motion in the wedge adjoining the static contact area. The limiting conditions of surface motion and pressure for the maintenance of an unbroken film for a comprehensive range of combinations of materials and lubricants are not precisely known, and much work remains to be done on the subject. Speeds, surface stress factors, calculated maximum surface pressures (if static conditions are assumed) and sliding velocity of various types of drive at various loads are tabulated. To put the selection of gear lubricants on a rational basis, the establishment of a "film destruction criterion," taking these values and materials of construction into account, is needed. The following generalizations have been drawn as a result of experience with gears of the "direct-acting" types: (1) For straight mineral oils of a given base the higher the viscosity the lower the coefficient of friction under conditions of gear-tooth engagement. (2) For the same viscosity the coefficient of friction is appreciably lower with paraffin base than with asphaltic or naphthenic base oils. (3) Excessive refinement, and the use of some solvent extraction processes, are liable to increase the coefficient of friction and involve the risk of more rapid tooth wear. (4) Practical results show that oils with a lower coefficient of friction (see 2) give greater protection against wear, but it cannot be said that this invariably holds good, or that it applies to extreme pressure lubricants. A table of abridged specifications based on viscosity at 140° F., gravity and cold test is given. Another table indicates the field of application of the various grades of oil for spur, helical and bevel gears loaded to full capacity, and from which maximum performance and endurance are required. For worm-gears the emphasis is laid on

the coefficient of friction, to which, other things being equal, the efficiency loss by tooth friction and the temperature rise are proportional. Coefficients of friction for the graded lubricants, as determined in a special disk machine, are shown graphically against rubbing speed. This type of tester is useful in selection of oils for vehicle rear-axle drives, which, of all types of worm gears, require the greatest care in selection of oil. Of oils tested in this way by the author, the addition of extreme pressure base (with one exception) does not reduce the coefficient of friction; whether it reduces tooth-wear of worm gears remains to be proved. R. A. E.

432. Ball Bearings for Hot Shafts. A. Meyer. *Proc.*, 1938, **2**, 104–106.—A method of securing satisfactory operation of ball and roller bearings in exhaust gas turbines at both high temperatures and speeds of rotation is described.

In order to minimize the effect of heat transfer from the shaft on the differential expansion of the inner and outer races, and therefore the clearance, a thin sleeve was fitted to the part of the shaft carrying the inner race; this sleeve rested on it at small surfaces at each end only.

With abundant oil-cooling and suitable shields provided to avoid high bearing losses due to pumping action of the bearing, this method of preventing undue heating and destruction of ball and roller bearings has been successfully applied during the last few years, not only for new machines, but also in several cases where normally mounted ball and roller bearings failed completely. E. F. C.

433. Extreme Pressure Lubricants and Lubrication. F. L. Miller. *Proc.*, 1938, **2**, 107–117.—Increase in gear tooth loads of recent years has necessitated the use of extreme pressure lubricants. Such lubricants should (1) possess high load-carrying ability, (2) not lose their load-carrying ability, (3) not cause wear owing to the presence of abrasive or corrosive compound, (4) not cause corrosion of the operating or other parts, (5) not oxidize or thicken too rapidly in service, (6) not "channel" or foam. Essentially only three elements—lead, sulphur and chlorine—find commercial application in providing extreme-pressure properties. The number of promising types is limited largely to the following: (1) sulphur alone, (2) sulphur and chlorine, (3) sulphur, chlorine and lead, (4) lead and sulphur (inactive), (5) lead and sulphur (active).

The most important single property of an extreme-pressure lubricant is its load-carrying ability. Results of tests carried out in different test machines differ widely, but the S.A.E. machine generally shows the most consistent correlation with actual gear performance. Active lead–sulphur lubricants show the highest load-carrying capacity in this machine. All samples of such lubricants tested in proving-ground gear tests with Chevrolet cars and hypoid axles and reported by Zwahl performed satisfactorily without scoring of gears, whereas many samples of other types failed.

The loss of extreme-pressure properties in use may be gauged by heating the lubricant to 200° F. in the presence of metal, such as steelwool, and subsequent testing. Some types lose their extreme-pressure properties, but active lead–sulphur products, properly made with suitable base stocks, correct incorporation of the optimum quantity of sulphur in the oil, and proper blending of the lead soap, do not lose their properties even after long use.

Experience and laboratory tests indicate that extreme-pressure lubricants of the proper type and of sufficiently high load-carrying capacity will not cause undue wear of gears. Whilst extreme-pressure agents tend to decrease resistance to oxidation, the effect is slight, and it is possible to make products which are practically as stable as the base mineral oils themselves. Exceptional stability against oxidation and thickening is probably necessary only under the most severe conditions. Results of heating tests on the viscosities of mineral oil bases with and without addition of active sulphur–lead bases are tabulated. At present there are no adequate laboratory tests which will predict the extent or degree of corrosion to be expected in service.

Channelling and foaming characteristics are important, but no satisfactory test methods are available.

Further research on the choice of ingredients and on test methods is required, and the S.A.E. is continuing its studies of the problems raised. R. A. E.

434. Application of Cutting Fluids. J. F. Miller. *Proc.*, 1938, **2**, 118–123.—The article is primarily concerned with the application, from the chemist's point of view,

of cutting fluids in the machine shop, and the trouble which may arise from the influence of extraneous machining conditions.

Most of the difficulties with soluble oil emulsions are due to non-adherence to makers' instructions, use of hard water, or of a type unsuited to the metal being machined. Causes of discoloration arising from presence of rust and of copper in the metal being machined are dealt with and recommendations made.

With straight oils smoking is perhaps the most frequent trouble, and may be due to exceptional surface speeds, heavy cuts on tough materials and inadequate flow of oil, either separately or in combination. It may also be due to use of oil of too high a viscosity. It is thought that isolated outbreak of dermatitis and skin complaints can be more often traced to the operative than to the cutting oil, and adequate protection instruction should be given. It is probable that a proportion of strongly polar compounds—*e.g.*, alcohol—will be introduced into cutting fluids for extremely severe service in the future. R. A. E.

435. Lubrication of Wire Ropes for Hoisting in Mines on the Witwatersrand Goldfields. W. G. C. Nixon and W. G. Jackson. *Proc.*, 1938, **2**, 124–128.—An examination has been made of the composition of external dressings used for wire ropes and of the service conditions of use in thirty-nine mines.

The analysis of the data submitted gives evidence of such contradictory nature that no particular point of importance can be defined. The basis of the choice of wire-rope lubricant would appear to be one of economy consistent with maintenance of adequate protection of rope from corrosion. It is apparent that good internal lubrication is essential, and this is a matter for the rope manufacturer. It would be a step in the right direction if each wire-rope manufacturer gave a choice of external lubricants to be used, so that external dressings which are deleterious to the internal lubricant would not be applied. Further information required on external lubrication is enumerated.

Although it was found that ropes are well protected from corrosion during their working life, a scientific examination might lead to results which would give better rope lives. R. A. E.

436. Lubrication of Pivots of Light Mechanisms. R. S. Parker. *Proc.*, 1938, **2**, 129–132.—Lubrication of light mechanisms of the clockwork type is considered. The possible combinations of moving elements are numerous, and some of the prominent classes are described. Owing to the relative minuteness of the wearing surfaces to be lubricated and the general inability of surrounding surfaces to provide a reservoir, the main oiling must be performed during assembly. Intermediate replenishment between dismantlings for repairs or cleaning is necessary, and can usually be performed only with a brush or feather.

The lubricant must be chemically inert, non-corrosive to parts contacted, must give a tenacious and adherent film and be of satisfactory mobility. Certain fixed oils were formerly used, but tend to oxidize and become gummy in use. Suitable mineral oils are now available, and possess several advantages over the fixed oils. Only the best quality should be used, as results obtained with cheap and high-grade oils indicate. Many gels employed as filtering media to purify mineral oils are slightly soluble in, or microscopically miscible with, the warm oil. It is vitally important that these gels be completely removed from the oil before use, for their accumulation not only causes cloudiness when the oil chills in cold weather, but they deposit themselves in the holes and journals in which the spindles work, and cause at least retardation of the movement, if not final clogging. R. A. E.

437. Some Practical Considerations in the Lubrication of Roller and Needle Roller Bearings. C. G. H. Richardson. *Proc.*, 1938, **2**, 133–139.—The requirement of a roller-bearing lubricant may be summarized as follows: (1) To minimize internal sliding friction in the bearing; (2) to protect the highly polished surfaces from corrosion; (3) to dissipate heat generated by deformation due to loads carried by the rollers and tracks; (4) to act as a seal against the ingress of moisture or foreign matter of any kind.

In a roller bearing, the high unit pressures obtained definitely preclude maintenance of an unbroken oil film between the loaded portions of the bearing.

Oil is the ideal form of lubricant, but owing to simpler retention designs required, grease is employed where possible. For needle roller bearings oil should always be used, except where loads are negligible or the bearings are used for oscillating motion only. Uses of lime-base and soda greases are considered. The use of lime base greases is limited to comparatively light duties, particularly where extreme moisture conditions prevail, as the insoluble lime soap provides an effective seal against ingress of water. Applications of soda greases of low and high soap content are discussed. The design of roller bearing housings, the extent to which housing should be packed and frequency of replenishment are considered. Failure of grease lubrication, assuming a suitable grease is selected, is generally due to one of the following conditions: (1) escape of grease due to inefficient sealing of the housing; (2) evaporation of oil from the lubricant due to high operating temperatures; (3) too large a space in the housing, allowing grease to be thrown clear of rotating parts; (4) initial application of too much grease in a housing, resulting in oil separation.

Where oil is used, only pure mineral oils should be used, but choice is often difficult, as the same oil is often required to lubricate other parts, such as gears, etc. The lightest oil which will cope with the conditions imposed should always be chosen to avoid unnecessary frictional losses. For speeds up to roughly 4000 r.p.m. and temperatures not exceeding 140° F., oil of viscosity R.I. at 140° F. of 250/400 secs. should be satisfactory. For slow speeds, but temperatures of 140/250° F., a cylinder oil of viscosity R.I. 150/170 secs. at 200° F. is recommended. For high-speed applications such as textile spindles a light spindle oil is, of course, essential.

Oil-lubrication systems are discussed, and their limitations indicated. Limited experience with extreme pressure lubricants indicates that care in selection is necessary to avoid corrosion of brass and bronze cages, but they may have a beneficial effect on the life of rather heavily loaded bearings. For very high temperature work where needle roller bearings are used, the most suitable lubricant is colloidal graphite, applied in admixture with a volatile oil which is burnt off in use and leaves an even film of graphite. R. A. E.

438. Lubrication in Relation to Pivots and Jewels in Electricity Meters. G. F. Shotter. *Proc.*, 1938, **2**, 140–144.—The lower bearing of an electricity meter usually consists of a hardened ball-ended steel pivot (r = 0·015–0·035 ins.) which rotates on a highly polished sapphire jewel cup (jewel radius 0·04–0·075 ins.). Although weights imposed on the bearings are small, initial pressures exerted on the pivot are in the neighbourhood of 75 tons per sq. in. Without lubrication, ferric oxide is found in the jewel cup, resulting in slowing up of the meter. When the débris is removed, the surfaces of pivot and jewel cup are found to be rough, the friction still being fairly high. When the bearing is lubricated, ferric oxide is still found, but it is dispersed throughout the oil, providing this is sufficiently viscous. The surfaces of jewel and pivot are polished after use, and after the unit has been cleared, friction is very small.

Results of tests carried out with a view to selecting a suitable lubricant are described, and the requirements to be fulfilled are listed. There appears very little doubt but that an oil film exists between the bearing surfaces, despite the high pressure between them. Pennsylvania oil refined by the " Alchlor " process shows advantages over an oil of the medicinal paraffin type. Pennsylvanian oil of viscosity R.I. 6600 secs. shows little difference in friction as compared with Pennsylvanian oil of viscosity R.I. 1400 secs. R. A. E.

439. Some Experiments on the Lubrication of Pivot and Jewel Bearings. V. Stott. *Proc.*, 1938, **2**, 145–152.—Results obtained in a general investigation on the lubrication of pivot and jewel bearings at the National Physical Laboratory are described and discussed. The tests have shown that: (1) with a steel pivot and sapphire jewel, lubrication had markedly beneficial effects; (2) with a sapphire pivot and sapphire jewel, over a short run of only 2 million revs., there was little difference between the increase in friction when the combination was lubricated and when it was not; (3) with a steel pivot and diamond jewel, friction remained small over a long period (3½ years) and for a large number of revolutions (50 million) with no lubrication.

Results show clearly that lubrication must be studied separately for each combination of materials used for pivots and jewels.

In a pivot-and-jewel bearing of the type dealt with, the function of lubrication is not to reduce initial friction, but to maintain a low value for friction over a long period.
R. A. E.

440. Lubrication in Wire Drawing. F. C. Thompson. *Proc.*, 1938, **2**, 153–161.—Stress on the various portions of a wire-drawing die may attain very high values, of the order of 100 tons per sq. in., in heavy reduction of high tensile steels. The need for adequate lubrication is therefore apparent. A variety of tests carried out indicate that the lubrication is almost undoubtedly of the " boundary " type.

The effect of efficient lubrication on the reduction in temperature of dies, and consequently on their life, is considered, and the effect of temperature on tension when various liquid and solid lubricants are employed has been investigated. The addition of graphite to wire-drawing soaps appears to be advantageous, but in the case of liquid lubricants may give rise to uneven drawing under certain conditions. The advantages and disadvantages of surface coatings of lime, copper and lead are discussed. Contrary to past conceptions, the author's experience is that the most efficient lubricants for steel have been equally efficient for non-ferrous metals.

Where subsequent treatment of the wire, such as enamelling, is to be employed, a bright surfaced wire is at times preferable, and the use of an inefficient lubricant is probably desirable. Water at a temperature just below the boiling point is a moderately efficient lubricant, and has given a bright-surfaced wire satisfactory for subsequent coating.
R. A. E.

441. Gear Lubrication : The Application of Lubricant. W. A. Tuplin. *Proc.*, 1938, **2**, 162–166.—Having selected a gear lubricant which will give the necessary protection to the tooth surfaces, it must be applied so as to (*a*) conduct frictional heat away from the teeth, and (*b*) avoid excessive oil-churning losses. The method of application will vary with the viscosity of the lubricant and the speed of the gears.

The limitations, method of operation and general application of hand application, dip, spray and jet lubrication systems are considered, and the types of oil or grease most suited for each method are specified. Design requirements of the systems to ensure best lubrication and maximum overall efficiency are discussed. R. A. E.

Group IV.—Properties and Testing.

Report on Papers in Group IV. Properties and Testing. H. J. Gough. *Proc.*, 1938, **2**, 465–472.—The papers of this group may conveniently be discussed under the four headings: (1) Boundary Lubrication and Wear, (2) Viscosity, (3) Oxidation Tests, and (4) The Testing of Ball Bearing Greases.

(1) *Boundary Lubrication and Wear.*

Adam contributes an interesting review of surface phenomena, describing the mechanism of seizure of clean surfaces, and the function of the boundary layer in first cushioning the contact between the roughnesses of the surfaces, and then providing easily-broken connections when there is approach within the range of molecular attraction. *Kyropoulos* attributes the advantage derived from longer molecules, not so much to the greater elasticity of those molecules, as to the consequent increase of internal molecular mobility.

Both authors emphasize the small range of the surface forces, and this is interesting in view of the known differences of friction obtained with different metals. *Adam* favours a single, or at most a few molecular thicknesses to the boundary layer, and *Finch* and *Zahoorbux* show that the electron-diffraction pattern showing orientation disappears with the third molecular layer. With regard to commercial oils with their very different components, *Kyropoulos* points out that the boundary layer would, to some extent, be expected to change continually in composition. In this connection, he claims that the only direct method by which measurements can be obtained of molecular anisotropy *and* concentration of the desirable long molecules in coloured oils is his flow-orientation method—a hydrodynamic treatment of the oiliness problem. *Trillat*, however, finds adsorption with commercial oils as with oleic acid–oil mixtures,

and in fact puts forward his interfacial tension method as one very sensitive and suitable for the examination of commercial oils, expressing the activity in equivalent oleic acid contents.

Many references are made to surface finish and reveal a very satisfactory appreciation of the relatively enormous size of the irregularities of even a finely-finished surface in comparison with the thickness of the boundary layer. As *Kyropoulos* points out, the difficulties in the experimental study of boundary lubrication are largely due to this interference of the surface irregularities in the tests. Both *Heidebroek* (in a paper in Group I) and *Brillie* point out that even in the hydrodynamic region of thin film lubrication of bearings, these irregularities have a local influence on pressure film formation.

The consideration of high-point contact in relative motion leads logically to the mention of the high temperatures produced at those contacts which have been demonstrated by *Bowden* and, later, by *Blok* for gear teeth. (See Paper in Group III.—Abs. No. 419.)

By means of a wear-and-friction-testing machine, in which bronze buttons wear on a hard steel track, *Neely* shows that the effectiveness of addition-agents on the wear-reducing value of lubricants may be quite different in degree, and sometimes in direction from the effect of friction: in that author's opinion it is therefore futile to attempt to predict wear-reducing value from friction tests. *Clayton* describes tests in the four-ball apparatus under sliding contact with hard steel balls. *Brownsdon* has tested the effect of a large number of substances when added in small proportion to a mineral oil on the wear of brass by a hard steel wheel. *Southcombe*, *Wells* and *Waters* have carried out tests under a variety of conditions using a Timken machine. These authors state that the property of certain lubricants which has been called "high-film strength" does not appear to exist, and they conclude that an extreme pressure lubricant must be defined as one which permits the metal to wear away smoothly when the load intensity approaches a certain limiting value—under their conditions of test. *Van der Minne* describes results of tests on a series of oils with four testing machines. He explains the marked differences found as being due to differences of duty (load and speed): at low duty, "oiliness" characteristics are advantageous, whilst at high duty the high temperatures bring out the good features of the extreme pressure lubricants. Ordinary "oiliness" characteristics may be a disadvantage under extreme pressure and temperature conditions.

(2) *Viscosity.*

Groff describes the use of a chart for the graphical solution of a number of problems relating to the viscosity–temperature characteristics of oils.

When the need for more accurate viscosity measurements arose 5 years ago, the American Society for Testing Materials investigated the use of capillary tubes, and have now adopted this method as a tentative standard. As in England, a resolution of the Petroleum Congress of 1933 has thus been implemented.

Barr describes the viscometer bath arrangements he has used for high-temperature measurements. He then considers several formulæ which have been proposed for expressing the relation between viscosity and temperature, and suggests a new empirical formula which gives better agreement with experiment than Walther's.

The papers by *Groff* and *Barr* simplify the use of viscosity data for the practical user, whilst *Geniesse's* paper is important from the point of view of international standardization and simplification.

(3) *Oxidation Tests.*

Considerable attention is given by the authors to the problem of the oxidation of internal-combustion engine oils. *Moerbeek* points out the unsatisfactory character of the multitude of oxidation tests that have been, and are being, suggested; disagreement is shown between the results of different tests, whilst there is correlation between these results and the behaviour of the oils in actual engines. *Von Philippovich* gives an able review of the many difficulties and necessary reservations in laboratory and engine tests. He considers the chief task awaiting research is to carry out a systematic determination of the conditions under which the lubricant works in an engine, and to develop methods in which the oils are exposed to these conditions or tested within the appropriate range of temperatures. In the light of these comments it is interesting to consider the other papers in this section. *Mardles* and *Ramsbottom* give extensive results of the type favoured by *von Philippovich*. *Hanson* and *Egerton*

introduce what appears to be a new factor into the problem. They are interested in gumming as affecting ring-sticking. In a modified Air Ministry test they have found nitrogen oxides in a concentration similar to that in the engine to have a marked catalytic effect on oxidation. *Evans* and *Kelman*, on the basis that oxidation occurs on the cylinder walls of an engine, have heated the oil at 180° C. in a Petri dish in the presence of iron, and claim that the consequent viscosity modifications are in closer correlation with engine tests than when blowing and absorption tests are carried out. While *Moerbeek* is pessimistic regarding the value of oxidation tests for internal-combustion engine lubricants, several other authors present encouraging results which raise the hope that the present concentration of attention will lead to the development of some laboratory test, or tests, which will give a satisfactory guide to the behaviour of an oil in an engine.

(4) *The Testing of Ball-bearing Greases.*

Kjerrman, also *Cooper* and *Richardson* in papers in Group III, refer to various tests of ball-bearing greases. The importance of the practical running test is emphasized. Laboratory tests mentioned include drop points, acidity or alkalinity, content of foreign particles, etc.

442. Molecular Forces in Friction and Boundary Lubrication. N. K. Adam. *Proc.*, 1938, **2**, 197–201.—This paper contains theoretical speculations and considerations regarding the molecular mechanism of friction and lubrication.

The field of force extending outwards from a solid surface is very powerful, and extends only from 1 to 3 Ångstrom units (1 Å = 10^{-8} cm.). The force probably falls off according to an inverse sixth power.

The phenomenon of a "seized" surface is explained as a welding together of the points of contact of two surfaces when the latter approach within one or two Ångstrom units of each other. The paper proceeds to explain the tremendous irregularity of an optically plain surface when considered from a molecular point of view, and the effect of small contaminating films in reducing the tendency to seizure is pointed out.

The mechanism by which a molecule of fatty acid is adsorbed on to a solid surface is explained, and the part such a molecular film plays in averting seizure is discussed.

The permanent preservation of a boundary film is important, and it is suggested that a reserve supply of the active molecules should be present in the lubricant, and a high adhesion of the polar body to the solid surface is necessary. High boiling point, which generally means a heavy molecule, is desirable, so that the heat generated shall not easily displace the film. Chemical stability is also important, as the boundary lubricant must resist decomposition. The main function of such a boundary lubricant is to provide a weak link in the junctions or bridges formed between the elevations on the surface at the points where contact is close enough for the molecular attractions to spread; thus on renewed movement the boundary film breaks, and not the metal.

W. E. J. B.

443. Sludge and Deposits in Turbine Oils. W. O. Andrews. *Proc.*, 1938, **2**, 202–208.—To assess the resistance of a turbine oil to emulsification and oxidation, two new tests are proposed for which the merit of simplicity is claimed. The R.L. emulsion test consists in producing the requisite water-in-oil emulsion by properly shaking the two components in a 2-oz. bottle and noting the rate of separation at 130° F. In the ageing test (apparently a variation of the Brown–Boveri test) the oxidation is carried out for periods of 1 and 6 hrs. The aged oil must not show any deposition of sludge after standing over-night. If it does, then the oil must be filtered before the R.L. emulsion test is carried out. The criterion for demulsibility after ageing is the same as for the new oil. Details of the practical tests are given. J. L. T.

444. Flow Characteristics of Petroleum Lubricants. D. P. Barnard. *Proc.*, 1938, **2**, 209–216.—In the main this paper is a recapitulation of the work of Arveson published in the *Journal of Industrial and Engineering Chemistry* in 1932 and 1934.

A discussion of the constant shear viscometer used by Arveson is given. A new observation by Arveson is recorded concerning the viscosity exhibited by a wax bearing oil at various temperatures and various rates of shear. The results are

recorded graphically, and it is seen that this oil, which had an A.S.T.M. pourpoint of about 65° F., shows viscosity peculiarities up to approximately 110° F. Below 110° F. the actual viscosity obtained is determined largely by the rate of shear. As this rate of shear decreases, the apparent viscosity increases.

Some other data are given showing how oils which have been improved in viscosity index by the addition of special materials can show variable viscosities, depending on the rate of shear—*e.g.*, at a rate of shear of 10^3 reciprocal seconds—the apparent viscosities of the oils in question were about 10% lower than the viscosity as indicated by the Saybolt viscometer.

The author stresses the need for studying the characteristics of such oils, in such an instrument as is described in the paper. W. E. J. B.

445. Determination of the Viscosity of Oils at High Temperatures. G. Barr. *Proc.*, 1938, **2**, 217–221.—The author favours the use of a vapour-bath as a thermostat for viscosity determinations at temperatures over 180° C., and a suitable arrangement is described.

The paper next considers the relation between viscosity and temperature for oils. Reference is made to a paper by Erk and Eck (*Physik. Zeit.*, 1937, **37**, 113) in which the Vogel formula, the Walther formula, and the so-called Andrade formula were tested against accurate determinations. The results were that the latter formula was considered unsuitable for oils, and the former the most suitable.

The author considers the Craigoe equation, but has found it less satisfactory than that due to Walther.

The most satisfactory agreement with experimental data is stated to be obtained by means of a formula which is believed to be new, namely :—

$$(\log_{10}(\nu + a))^{0.3} = A + b/T$$

where $a = 0{\cdot}8$ and ν = kinematic viscosity in centistokes. A and b are constants.

Barr has tested this formula with viscosity data for oils between 20° and 80° C. provided by Erk and Eck, and also against data by Fortsch and Wilson for oil fractions up to temperatures of 255° C. On the basis of these tests Barr considers the new formula superior to that of Walther, but admits that more extensive tests will be necessary before the new formula can be accorded preference on the grounds of accuracy in general work. W. E. J. B.

446. Theoretical Study of Temperature Rise at Surfaces of Actual Contact Under Oiliness Lubricating Conditions. H. Blok. *Proc.*, 1938, **2**, 222–235.—The author develops from theoretical considerations an equation which will give the temperature rise at a point of contact between two metals under boundary conditions of lubrication. The calculation appears also to be applicable to cases of extreme mean pressures (10,000 kg./sq. cm.), examples of which are the Timken machine, etc., and cutting tools. Examples are worked out for different types of heat distribution assuming a definite source of heat. The interesting conclusion is arrived at that a moving source of heat may be treated as stationary.

This theoretical consideration is then enlarged to include sources of heat such as occur by frictional contact. It is concluded, as is found in practice, that the temperature rise at such points of contact can be extremely high, and an example is given in which it is calculated that under certain conditions a temperature rise of 360° C. may be expected. C. H. S.

447. Friction of Sliding Metals. Part I. High Temperature of Lubricated Surfaces. F. P. Bowden. *Proc.*, 1938, **2**, 236–239.—The surface temperature of rubbing metals has been measured by using the rubbing contact of two different metals as a thermocouple and determining the e.m.f. generated on sliding.

Typical results for lead sliding on mild steel are shown. The surface temperature rises as the speed of rubbing is increased until the melting point of the lead is reached. According to the load applied, the melting point is attained at a lower or greater speed as the load is greater or smaller. With metals of high melting point local surface temperatures of over 1000° C. have been reached. Even when lubricant is present, local temperatures of 500° C. or more may be attained.

Experiments on the polishing and surface flow of metals have shown that the formation of the Beilby layer readily occurs, provided the melting or softening point of the metal is lower than that of the polisher. Relative hardness as measured at room temperature is comparatively unimportant, thus when Wood's alloy (m. p. 69° C., Vickers hardness 24) is rubbed with a block of camphor (m. p. 178° C., very soft), surface flow of the alloy occurs.

The above results are applied to a consideration of bearing-surface properties, and it is pointed out that a non-homogeneous bearing alloy may be pitted owing to parts of the surface melting under the influence of the high temperatures set up by rubbing contact.

Part II. The Nature of Sliding. F. P. Bowden and L. Leben. *Ibid.*, 239–240.—When steel slides on steel at slow speeds, the frictional force is not constant, but is undergoing violent fluctuations. The top surface sticks to the lower one, and moves with it until it is no longer able to withstand the increasing pull of the friction measuring device used. A sudden and rapid slip then occurs. The process is repeated indefinitely.

With a new apparatus the authors have shown that the surface temperature fluctuates with this slip, and in fact that a sudden rise in surface temperature occurs at the same instant as the slip. It is at the instant of slip that wear and abrasion of the surfaces may occur. W. E. J. B.

448. Influence of Increase of Temperature of Oiliness and of Surface Conditions on Viscosity. H. Brillie. *Proc.*, 1938, **2**, 241–253.—Viscous friction is considered to be the result of reciprocal action of the fields of force of the molecules constituting the superimposed layers of lubricant comprised by the bearing surfaces. For every molecule there is a sudden increase of the vibratory energy, and consequently a sudden increase in the temperature. Hence for any point of the film there is an increase of temperature which can be calculated in accordance with the theory of viscosity. These temperature increases of oil are very important with high speeds and small bearing clearances.

The author next considers surface conditions and their effect on friction. Ultimately an equation is obtained which expresses the coefficient of friction in terms of the combined influence of oiliness and surface irregularities. W. E. J. B.

449. Some Observations on the Effect of Added Substances on the Lubricating Properties of Oils. H. W. Brownsdon. *Proc.*, 1938, **2**, 254–260.—An experimental study was made, using the author's well-known "wear-test" machine, into the effect of the addition of some eighty-five substances, in concentrations varying from 0·005% to 100%, to a light machine oil (40 Redwood secs. at 200° F.). The substances added varied in nature from gases—*e.g.*, NH_3 and H_2S—to solids—*e.g.*, sulphur and arsenious chloride—and include inorganic acids and aqueous solutions of inorganic salts. It was found that low mol.-wt. acids are more active than high-mol.-wt. acids, and since dilute H_2SO_4 had some activity, it is considered that some property besides acidity must be looked for to explain the activity of acidic solutions. Other substances can also cause wear reduction, *i.e.*, inert volatile materials preferably of low solubility in oil (*e.g.*, alcohol), reducing agents, gases, film forming substances, etc. No single characteristics of these many substances can be put forward as the cause of their behaviour. The effect might be chemical or physical, or a combination of both, and since some products are decomposed under the conditions of temperature and pressure, the effect is probably due to the decomposition product rather than to the pure substance itself. It is considered that the results are not without bearing on more general problems of lubrication. J. L. T.

450. Oiliness in Relation to Viscosity. A. W. Burwell and J. A. Camelford. *Proc.*, 1938, **2**, 261–273.—One is reminded that Hersey in 1914 originally defined the function Z in the familiar $\frac{ZN}{P}$ expression as the *effective viscosity in the film*. The authors consider that it is erroneous to define Z as the viscosity of the oil in bulk at the bearing

temperature. Their statement is supported by their experience of different friction coefficients, even in the fluid film region obtained on oils of comparable viscosity.

Pressure–friction and temperature–friction results were obtained using a modified Moore–Carvin friction machine and a bronze–steel combination. These results indicate a continued reduction of friction with increase of temperature, even in the boundary layer region on a mineral oil containing an addition agent (nature unspecified). It is considered that this is due to the thin film being a plastic solid which melts as the temperature is increased and produces viscosity effects. Four generalities are deduced :

1. Transition from full fluid film to adsorbed or oiliness film is normally gradual.
2. Adsorbed or oiliness films may be of any density or physical condition—solid, viscous, or extremely fluid.
3. Whether or not a full fluid film is present, the assumption that the viscosity of the film is identical with the pressure viscosity of the film as a whole cannot be justified.
4. A lubricant can function in three distinct regions without permitting complete breakdown. These are : (*a*) full fluid film, (*b*) adsorbed film, (*c*) a region in which the lubricating film is repeatedly ruptured and re-formed.

Experiments on the segregation of active (polar) groups in the lubricating oil showed that there was an increase in friction after contacting with various metallic powders, and a reduction in the rate of flow to a steady state of oil passing through capilliaries containing copper wire. This is due, it is thought, more to orientation of the polar groups on the surface of the metal than to selective adsorption. The need for intensive study of pressure–temperature–viscosity relationships is pointed out.

J. L. T.

451. Use of Four-Ball Extreme Pressure Lubricant Testing Apparatus for Ordinary Lubricants. D. Clayton. *Proc.*, 1938, **2**, 274–284.—Using Boerlage's apparatus and commencing with a load of 20 kg., rising by increments of 10 kg., a number and variety of substances were tested. Of the two mineral oils tested, one conventionally refined and the other solvent refined, the latter gave lower times to seizure and greater time to recovery from seizure and greater wear. Friction values were, however, the same for both oils at the same load. The following conclusions are reached. It appears that "oiliness" properties are being tested, as apparently there is no formation of a load-carrying fluid film. The order of increasing quality as regards breakdown load and wear with seizure is : mineral oils, fatty oils, and extreme pressure lubricants. Doubtless related to wear is the time to recovery from seizure, which is long with mineral oils (say, 10 to over 60 secs.), intermediate with fatty oils (3 to 6 secs.), and short with extreme pressure lubricants (1 to 2 secs.). The coefficient of friction generally rises at seizure to 0·35–0·55. Glycerin has intermediate properties, whilst syrup behaves like an extreme-pressure lubricant. A mineral oil, only moderately refined and presumably containing a high proportion of unsaturated compounds, behaved in some respects like a fatty oil. The addition of colloidal graphite or small quantities of water to a mineral oil has a slight deleterious effect, but with larger quantities of water the breakdown load increases again. Additions of oleic acid and rape oil to mineral oils have a small beneficial effect.

J. L. T.

452. Metallic Soaps in Lubricants. E. A. Evans and A. L. Kelman. *Proc.*, 1938, **2**, 285–294.—A brief historical survey of the development of the use of metallic soaps in lubricants is given, and the article is then devoted primarily to the inhibiting effect of metallic soaps on the oxidation of oil. Laboratory oxidation tests are incomplete methods of assessing the resistance of oil to deterioration, and it is held that only engine tests are satisfactory. A general criticism of some of the oxidation tests is made, and it is pointed out that the air-blowing test does not reveal the inhibiting characters of certain compounds. Increase in viscosity is a better indication of oil deterioration than increase of acidity or solid oxidation products. Hence in a series of experiments recorded, the method of oxidation of oils has been to heat them in a Petri dish at 180° C., and deterioration is assessed by measurement of the increase in viscosity, acidity and solid bodies.

The results of these experiments are tabulated and discussed. They indicate that

whereas metallic soaps accelerate oil oxidation, the effect of tin and chromium is very small in comparison with that of iron and copper, particularly the former. The results also suggest the possibility that the products of oxidation co-ordinate with the metallic soap to form a body having greater catalytic effect than the original oxidation products.

That, in practice, such soaps as those of tin inhibit oxidation is explained by the theory that they smother, or inhibit the formation of, the far more reactive iron soaps. Experiments supporting these theories are described, and engine tests on several inhibitors favour mixtures of tin and chromium oleate.

In general, the only inhibiting metallic oleates are those containing tin, chromium, nickel, thallium or titanium, and the acid radical does not materially affect the inhibiting action. T. C. G. T.

453. Study of Wear and Lubrication by Electron Diffraction. G. I. Finch and F. D. Zahoorbux. *Proc.*, 1938, **2**, 295–301.—Surfaces of metals vary according to the nature of the finishing treatment they receive. Thus cutting or abrasive methods leave its structure crystalline (indicated by a sharp-ring electron-diffraction pattern). Hammering, burnishing and polishing produce the well-known Beilby layer with a diffuse halo electron-diffraction pattern, characteristic of a liquid surface. Transformation from the smooth to the crystalline state occurs spontaneously even at room temperature in some cases, or in others under only moderate heating. The process of "running-in" is shown by electron diffraction methods to consist in a filling up of the valleys in a rough surface by material flowed over the top and down the sides of large-scale projections and frozen into the amorphous state, which is both hard and smooth. The production of this amorphous layer is considered essential for the maintenance of a stable oil film. Long-chain hydrocarbons in a monomolecular layer are orientated in such a way that they are vertical to the surface. Since they are non-polar, it is considered that this mode of orientation is due to lateral cohesion, rather than to surface attraction. It is shown that subsequent monomolecular layers are more poorly orientated, and it is considered they are more readily swept away. Therefore, it is important that the single monomolecular layer be as strong (*i.e.*, well orientated) as possible, and that no factor such as crystalline projections on the surface be allowed to prevent this. The effect of substituent groups at the end of the hydrocarbon chain is to cause more or less tilting from the vertical, according to the size of the group. The tilting is explained by the action of the lateral forces along the chain opposing the wider side spacing at the surface due to the substituent groups.

In mixtures of hydrocarbons and substituted compounds the vertical orientation of the former, is not affected, provided the concentration of the latter is not too great; *e.g.*, perfect orientation still persisted even when palmitic acid (which does not give a "layer-line" pattern) was present in 50% concentration. Owing to its layer-lattice structure, graphite not only provides an admirable temporary substrate for an orientated oil film, but also has lubricating properties of its own; as witness not only the self-lubricating properties of cast iron but also the formation of the graphoid surface on metals other than cast-iron. J. L. T.

454. Measurement of Boundary Friction in an Oscillating Bearing Machine. A. Fogg. *Proc.*, 1938, **2**, 302–307.—With journal bearings boundary conditions of lubrication do not usually occur except on such occasions as starting or, with an oscillating bearing, at the end of each stroke, when it is virtually at rest.

The machine used for the experiments is described, with drawings, and consists of a hardened steel shaft with a steel bush attached to an oscillating shaft and driven, through a torque meter, by a variable-speed motor. During the experiment the shaft is submerged in oil. The bush is grooved to try to eliminate full fluid film lubrication.

The effects of friction, frequency of oscillation, load and temperature are given in a table. It is concluded that at the lowest frequency of oscillation viscosity effects are absent, whilst chemical composition (oiliness) of the lubricant has considerable effect on the friction. Below three cycles/min. it is thought that the bearing is operating under complete boundary conditions, and therefore this offers a means of measuring boundary friction. C. H. S.

455. Viscometry as Applied to Petroleum Products in the United States. J. C. Geniesse. *Proc.*, 1938, **2**, 308–316.—This paper describes the suspended level viscometer originally

developed by Ubbelohde and modified by FitzSimons, and also the modified Ostwald viscometer developed by Fenske.

These viscometers are calibrated using water as the ultimate reference liquid. Its viscosity is taken as 1·007 centistokes at 68° F. A stepping-up process is used to calibrate the viscometers to be used with oils.

The paper contains a table which shows the comparisons between kinematic viscosity and Saybolt universal seconds at 100° F. Data were also obtained at other temperatures, and it was found that Saybolt seconds determined at $t°$ F. were equal to Saybolt seconds determined at 100° F. multiplied by the factor $1 + (t - 100)\,0{\cdot}000064$.

Thus the kinematic viscosity may be obtained from a Saybolt time determined at any temperature from 70° to 300° F.

The paper describes the revision of the A.S.T.M. viscosity temperature chart, which now becomes tentative standard D341–37T. Actually, four new charts have been constructed, two of which are in kinematic units. In three of the charts the value of the constant in the kinematic viscosity scale has been changed from 0·8 to 0·6, whilst in the low-kinematic viscosity-range chart the constant varies from 0·6 to 0·75.

The paper concludes by stressing the desirability of extending the use of kinematic viscosity. W. E. J. B.

456. Graphical Solutions of Viscosity Problems. J. Groff. *Proc.*, 1938, **2**, 317–324.—The author's treatment of the subject is described. A comprehensive nomogram is included. (See I.P.T. Abstract No. 49, 1938.) J. L. T.

457. Practical Running Tests with Gear Oils. A. Hagemann. *Proc.*, 1938, **2**, 325–333.—The researches discussed constitute part of an investigation on the driving mechanisms of automobiles, and concern the relations between the properties of the oils and the construction of the driving mechanism of power-driven vehicles. The object was to select oils which cause the least loss of power and minimize the stress of the metallic parts. Running tests on the test-bed were carried out with various oils on drives of types in current use. Abrasion was judged from the ash content of the oils. The temperatures, particularly under load, and the abrasion with different worms varied greatly under the same conditions of test, due to the varying suitability and play of the bearing surfaces and the assembly of the worm-gear. The size of the molecule, in the case of pure hydrocarbons, and the viscosity–temperature curve were shown to be of great importance. Abrasion was reduced by the addition of fatty oils to the paraffin base and synthetic oils, but the oiliness of the naphthene-base oil was too low, and led to destruction of the gear despite the addition of fatty oils. Resin was found to assist lubrication, and the supposition that resin plays a part in lubrication is now being examined. B. M. H. T.

458. Influence of Catalysts on the Oxidation of Oils. T. K. Hanson and A. C. Egerton. *Proc.*, 1938, **2**, 334–340.—An account of some preliminary investigations into the catalytic action of nitric oxide and nitrogen peroxide which are present in combustion with air, in more or less amount, in I.C. engines according as knocking is severe. Nitrogen peroxide is strongly catalytic, and not only shortens the oxidation induction period, but also increases oxidation. Tests were carried out on mineral, vegetable, and compounded oils by a modification of the D.T.D.109 method, and also by an oxygen absorption method. Results are tabulated and graphed. In both methods a thick gum always separates at the surface of the liquid, and the oil darkens much more rapidly, even though viscosity is very little changed, when nitrogen peroxide is present. It is considered that the presence of nitrogen peroxide might help to explain the rapid deterioration of the oil when once gumming starts, and also the increased tendency to gum when knocking occurs. Further engine experiments are in hand to determine the effects of nitrogen oxide on the oil in the engine, and on the relation to cylinder wear. J. L. T.

459. Testing of Ball-Bearing Greases. B. Kjerrman. *Proc.*, 1938, **2**, 341–345.—The most important test to be applied to a grease is a service test, and in the author's laboratory this is carried out on a bearing for 53 million revolutions, after which the lubrication must still be good and the bearing not worn. As far as laboratory tests

are concerned, it is considered that flow point and drop point are necessary, whilst ash content of the insoluble residue gives an insight into the presence of abrasive substances such as iron and silica. Since chlorine accelerates rusting, its content should not exceed 0·001%. Whilst a penetration test is considered necessary on a lime-soap grease, the warning is given that the reduction in consistency on working a soda or potash base grease may be so wrongly interpreted as to exclude otherwise satisfactory products. These greases, in contrast to the lime-soap greases, have the property of absorbing water to form emulsions which act as rust preventives. This property should be examined when testing. Among the tests which are considered useless and unnecessary are analysis for soap content, fat, fatty acids, glycerides and combined and free alkali. J. L. T.

460. Problem of "Oiliness." S. Kyropoulos. *Proc.*, 1938, **2**, 346–353.—The complexity of the "oiliness" problem is stressed, and oiliness machines which base their assessments of this property on film strength and bearing seizure, particularly the latter are shown to be fundamentally unsound.

The author sounds a warning against the tendency to develop for "oiliness" a physical chemistry of its own which disregards well-established experience and theories of physical chemistry.

The hypothesis of viscosity drop by molecular-flow orientation advanced by the author in 1928, and confirmed on Prandtl's machine in 1932, is recalled, and an attempt is made to give a lucid conception of "flow orientation" and the "absorbed state." T. C. G. T.

461. Oxidation Behaviour of Internal-Combustion Engine Lubricants. E. W. J. Mardles and J. E. Ramsbottom. *Proc.*, 1938, **2**, 354–366.—Extensive data are given for the oxidation of a series of oils by the following methods: (*a*) incubation in open dishes, (*b*) stream of air or oxygen, bubbling through the heated oil in a tube, (*c*) isothermal heating of the oil on the walls of a rotating bulb and the oxidation changes noted by chemical analysis and manometry, (*d*) vapour or spray of oil passed with air through a heated tube.

These oxidation tests were carried out over the temperature range 100–425° C. The catalytic action of various surfaces is studied, and data on the inhibitory action of various components are given. It is concluded that the oxidation behaviour of commercial lubricating oil is so complex that no single laboratory oxidation test appears to be adequate in deciding entirely the merits or demerits of any particular oil. J. W. H.

462. Oxidation Tests for Motor Oils. B. H. Moerbeck. *Proc.*, 1938, **2**, 367–371.—The increase in number and diversity of oxidation tests is considered by the author to indicate that the final selection of a satisfactory test to meet the undoubted need is yet to be made. Whilst some official and semi-official bodies tend to adopt new or revise existing test methods, and apply them to oils for which the test was never intended, other bodies are more cautious, and are careful to point out the limited correlation between laboratory and engine tests (see Abstract No. 301).

The author is not at all hopeful that any test will be devised to give results correlating with all classes of engines, or even with a reasonable percentage of one class, *e.g.*, Aero or Diesel engines. In the absence of such a test it is considered that the oil companies' recommendations are still the best guide. J. L. T.

463. Laboratory Test for the Study of the Ageing of Lubricants. R. Moutte, G. Dixmier and P. Lion. *Proc.*, 1938, **2**, 372–377.—The authors conclude that no method of artificial ageing is yet available which gives products identical with those obtained in an engine. Although present tests do give a necessary protection against oils of poor quality, it is hoped that in the future a more complete ageing will make it possible to differentiate between oils which now show little or no difference when aged artificially. Two methods are suggested:—

(1) Heating the oil to 300–400° C. after it has been sensitized by heating at a low temperature.

(2) Alternate heating at low temperature (100–140° C.) and at high temperature (300–400° C.), the heating at low temperature being more prolonged.

By this means it is hoped to simulate the ageing process rather than to accelerate it, since it is considered that the time factor relates to the quantity, and not to the quality of the products. It is proposed to neglect other factors (such as the action of the fuel) in arriving at a final ageing test.

The usually accepted criterion of solubility of products of ageing in chloroform is considered insufficient, and chemical identification or analysis of the products of ageing should be effected to complete the results. J. L. T.

464. Friction and Wear Comparisons for Lubricated Surfaces. G. L. Neely. *Proc.*, 1938, **2**, 378–385.—The interest in the above subject is primarily due to the study of the lubrication of cylinders and piston rings of I.C. engines. On investigating addition agents it is found that most oil soluble compounds will reduce the coefficients of friction for some operating condition, but the effect on wear may be different in degree and direction.

By the use of a special machine—the Kinetic Oiliness machine, Model B, U.S.P. 2,020,565—accurate data have been obtained of friction and wear concurrently under different operating conditions. The machine is described with the aid of a drawing and some photographs, and a description of the test procedure is also given. Results of a study of the effect of load, speed and addition agents are given.

These results are discussed with a view to their interpretation in relation to the much-discussed but ill-defined property of "oiliness." A definition of this property is given, and it is shown to be markedly affected by operating conditions, the metals used, temperature and rubbing speed. It is found that if the steel track has a smoothly ground finish, the friction is much higher than that with a mirror finish, and that the rate of wear is much higher. Also with a mirror finish the affect of addition agents is much less pronounced. In conclusion, the author believes that friction and wear are not correlated, and that a high degree of oiliness does not necessarily result in low wear. C. H. S.

465. Swedish Practice in the Standardization of Lubricating Oils. E. Norlin. *Proc.*, 1938, **2**, 386–392.—Lubricating oils are classified in Sweden by the Association of Engineers and Architects, whilst the Swedish Standardization Committee work on the standardization of testing and nomenclature. At present motor and transmission oils are classified according to their kinematic viscosities at 50° C., which are prefixed with the letters M and V, respectively. Specific gravity at present specified may disappear after revision now being undertaken. It is recognized that Pensky Marten flash-point is not necessarily a guide to volatility, and the evaporation test of Noack is being examined as an alternative. The present "viscosity-quota" (viscosity at 50° C.–viscosity at 100° C.) will probably be replaced by the viscosity index system for higher-quality oils. It is not certain yet whether pour point will be displaced by determination of viscosities at low temperatures. Higher limits for the Conradson carbon residue test are foreshadowed, but lower Sligh numbers are considered desirable for higher-quality oils. The oiliness of commercial internal-combustion engine oils is considered sufficient for operating conditions, and does not need to be checked. J. L. T.

466. Static Friction and Boundary Lubrication. M. E. Nottage. *Proc.*, 1938, **2**, 393–399.—Experiments are described and discussed which measure the friction in the limiting adsorbed layer between steel surfaces, and investigate the constitution of this layer and the effect of variation in the relative proportion of good and bad lubricants in a mixture.

Preliminary experiments utilizing mixtures of two substances of known lubricating properties and chemically inert to one another, such as caprylic acid and undecane or lactic acid and water, indicated that the more polar or surface-active substance is selectively absorbed by the solid surface, and that when the proportion of this constituent is greater than 0·7% it dominates the adsorption layer and the coefficient of friction. Thus an oil containing even a low percentage of a surface-active constituent has a lower coefficient of friction and greater resistance to film destruction than if it had not.

The film oxidation of oils gives rise to the formation of gummy products on hot metallic surfaces, and thereby lowers the seizing temperatures. Two mineral oils of different origin but of similar density and viscosity are shown to possess remarkably different seizing temperatures and coefficients of friction. A highly polar body such as palmitic acid, is shown to prevent the formation of this gum.

Though, in the experiments described, the bearing surfaces have been steel only, it is considered evident that the nature of these surfaces may influence not only the constituents of the adsorption layer, but also the changes which occur when the system is heated. T. C. G. T.

467. Experimental Study of Lubrication under Conditions of Extreme Pressure. J. E. Southcombe, J. H. Wells and J. H. Waters. *Proc.*, 1938, **2**, 400–411.—The authors describe investigations on various gear oils of the extreme pressure type. A study was made of the effect of rotating a cylindrical surface against a stationary plane by means of the Timken wear and lubricant tester.

The relationships of beam load to scar area, maximum intensity and average intensity have been determined. The application of these relationships to a Timken cup placed against a plane test block of 60° Rockwell hardness, gave the elastic contact area and values for the average and maximum intensities of pressure, for any applied load. The rate of wear scar formation was then measured on the Timken block with different lubricants at 400 ft. per minute with 215 lbs. dead load. The average intensity was calculated as 44,000 lbs. per sq. in.

It was found that a wide range of gear oils gave almost instantaneous wear, which in general did not increase with prolonged running. It appeared that the active extreme pressure agents gave a greater wear scar before this equilibrium was established.

A table gives the maximum permissible dead load, and it is interesting to observe that the highest load was carried by a sulphur-lead soap E.P. lubricant.

The authors suggest that the property of certain lubricants which has been called "high film strength" does not appear to exist, and conclude that an E.P. lubricant must be defined as one which permits the metal to wear away smoothly when the intensity of pressure approaches a certain limiting value.

Experiments under E.P. conditions with pure mineral oils yield a slight detritus which consists of oxide of iron and steel dust. The detritus product, when steel surfaces are lubricated with an E.P. oil containing organic sulphur compounds, always contains ferrous sulphide. Similarly, from organic chloro-compounds, ferrous chloride is found. The rate of decomposition of such compounds is thought to affect the breakdown load on the Timken machine.

The influence of speed on wear of the Timken block shows that the seizing load decreases as the speed increases. Within the limits of 70–200° F., temperature appears to be without effect on wear or seizing load.

In a special machine the coefficients of friction in the so-called boundary state have been examined for a typical mineral gear oil, and the same oil containing addition E.P. agents, under two widely differing intensities of load. These experiments show that the decomposition of the addition agent affects the result obtained.

W. E. J. B.

468. Physical Properties of Lubricants. Y. Suge. *Proc.*, 1938, **2**, 412–417.—With the object of ascertaining the physical meaning of "oiliness," certain physical properties of lubricants have been investigated.

The viscosities of thirty oils of mineral, vegetable and animal origin were measured at pressures up to 2000 kg. per sq. cm. and at temperatures between 0° and 150° C. The viscosities were determined by the falling-sphere method, the time of fall being observed by the aid of a high-frequency circuit based on the principle that the fall of the metallic sphere causes a change of capacity. This apparatus is illustrated. Three formulæ are given from which the viscosity of any oil at any temperature and at any pressure may be calculated, provided certain constants are known.

Other properties investigated were: solidification under high pressure, viscosities of compounded oils, compressibility, surface tension, thermal conductivity and the surface structure of oils on metal surfaces.

Compressibility was determined by measurement of the supersonic wave velocity. The compressibility of vegetable and animal oils is about 10% smaller than that of

mineral oil. It is known that, at constant temperature, the product of the surface tension and the compressibility of a liquid are almost constant, and a list of measurements of these two constants is given illustrating that the compressibility of an oil may be calculated from its surface tension.

The thermal conductivity was determined by the parallel plate method, and several values are listed. The conductivity of mineral oils, viz., about 0·0003–0·00035, was about 15% less than that of the vegetable oils tested.

The surface structure of oils after rubbing upon metal was investigated by the electron diffraction method. Grease alone exhibited a spotted, parallel line pattern, indicating strong orientation, whilst the rest of the oils tested gave diffuse ring patterns.

T. C. G. T.

469. Adsorption of Oils in Relation to Lubrication. J. J. Trillat. *Proc.*, 1938, **2**, 418–428.—The study of the interfacial tension of oil and water as a function of time is of great interest, as it is related to the speed of diffusion of the active molecules and their adsorption at the interface. This interfacial tension changes in time, depending on the hydrogen-ion concentration of the aqueous solution. The author has studied these changes in relation to impurities added to the oils, and the changes induced in the oils by heat, ultra-violet rays and use in an engine. The measurements of interfacial tension have been determined by a modified platinum-ring method.

The experiments described show the occurrence of selective adsorption, by metals and other bodies, of certain molecules normally present in, or added to lubricants. For example, in the case of a wick-fed, oleic acid containing lubricant, the oleic acid tends to be adsorbed on the wick. It is claimed that the experiments also make it possible to measure the approximate thickness of the boundary film and, in certain cases, to bring about the selection of given molecules or to measure the surface of adsorbent. The method is also claimed to provide a new and very delicate method for determining the quality of an oil as regards its activity or "oiliness."

T. C. G. T.

470. Comparison of the Behaviour of Various Extreme Pressure Lubricants in Different Testing Machines. J. L. van de Minne. *Proc.*, 1938, **2**, 429–441.—The general use of highly loaded spiral bevel and more highly loaded hypoid gears in cars has led to the search for, formulation and use of the so-called extreme-pressure lubricants. The high load and rubbing speeds of the gears caused teeth to score and weld with ordinary lubricants, and therefore the use of suitable lubricants became imperative. From past experience it was known that the addition of chlorine compounds, free and combined sulphur was useful for such work, and, naturally, most of these compounds have been used. As fluid film lubrication is impossible under such conditions, it is known that "chemical" lubrication takes its place, and that wear under these conditions need not be high, as a low coefficient of friction may even prevail.

The factors which must be taken into consideration in the rating of E.P. lubricants are: (1) wear, (2) coefficient of friction, (3) deterioration of E.P. properties with use, (4) corrosive nature, (5) foaming and (6) fluidity.

The working principles of various machines for testing E.P. lubricants are described, typical examples being the Four-ball tester, the Timken machine, the Floyd tester and the S.A.E. machine. The method of assessing results in each case is given, and the whole are summarized in a table and compared with conditions existing in the hypoid gear.

Another table gives the results of testing eight different oils, extreme pressure, fatty and straight mineral, on the four machines. It is found that the rating of the lubricants on the different machines appears to be very haphazard, no two machines rating the oils in the same order. These results are discussed and analysed in regard to oiliness, adsorption of polar compounds, etc. It is found that oiliness conditions exist only at low speeds and pressures, and that oiliness by itself does not improve lubrication at high speeds and pressures. The effect of temperature is discussed, and it is noted that with certain oils the coefficient of friction changes very rapidly with increasing temperature.

In concluding this analysis it is found that no machine, not even the S.A.E. machine, submits the oils to such exacting conditions as does the hypoid gear, and that no single

machine is suitable for testing all the lubricants used for different purposes. The only satisfactory test for the hypoid lubricant is the hypoid gear itself.

C. H. S.

471. Oiliness as a Result of the Heating of Lubricants. G. Vogelpohl. *Proc.*, 1938, **2**, 442–451.—In this paper the author states that the conception of oiliness presupposes the accurate determination of the true viscosity in the oil film. After reviewing the experimental methods employed for determining the temperature of an oil film in a bearing, the author concludes that the normal methods are insufficiently accurate. Moreover, a simple reading is not sufficient for the viscosity in the whole bearing to be deduced, since the temperature, and therefore the viscosity, are distributed too differently.

The author puts forward a new criterion for lubricants, which consists of the relation $\beta/\gamma C$, which represents the measure of the steepness of the viscosity curve divided by the product of the specific gravity and the specific heat. The smaller this value is, the better are the lubricating properties of the oil. B. M. H. T.

472. Principles of the Testing of Lubricants in the Laboratory and on the Test Bed. A. von Philloppovich. *Proc.*, 1938, **2**, 452—457.—The difficulties of making representative tests in the laboratory and on the test-bed, and the correlation of the results obtained to service conditions are discussed. Some tests on single cylinder engines are reviewed and the point is made that tests on one engine do not necessarily apply to another.

The conclusion is reached that until the conditions under which the lubricant functions in the engine are known it is only possible to test for a single characteristic at a time, *e.g.*, ring-sticking. C. H. S.

473. The Relations between the Chemical Constitution and the Properties of Lubricants. Dr. Zorn. *Proc.*, 1938, **2**, 458–463.—The chief properties of lubricants which could be improved, and the direction in which improvement could be made are as follows: (1) the temperature-viscosity relation, (2) resistance to ageing, (3) carbon formation, (4) oiliness. Although a little is known about the relation between chemical constitution and viscosity, the knowledge of the behaviour of well-defined hydrocarbons of high molecular weight when attacked by oxygen is unsatisfactory and further research is needed.

Cherneshukov and Krein have shown that aromatic hydrocarbons with side-chains are much less resistant to oxygen than those without chains, their resistance being less, the larger the number and length of the chains.

The ease with which naphthenes oxidize increases with rising molecular weight, and the introduction of side-chains again increases the sensitivity to oxidation. Reduction in sensitivity to oxidation is produced by adding aromatic hydrocarbons without side-chains, which act as "anti-oxygens." The addition of aromatic compounds with side chains, to the extent of up to 10%, also reduces the sensitivity of the naphthenes to oxidation. A further result of this addition is that asphaltic condensation products reappear amongst the oxidation products. The removal of aromatic compounds from mineral lubricants by catalytic hydrogenation under pressure, or by the use of selective solvent extraction, may thus improve lubricants as regards their tendency to form sludge and asphaltic substances. B. M. H. T.

BOOK REVIEWS.

The Practice of Lubrication. By T. C. Thomsen. 3rd Edition. Pp. xiv + 638. McGraw-Hill Publishing Company, Ltd., London. 1937. 36*s*.

Thomsen's well-known book far outstrips in detailed description other publications dealing with practical lubrication. An assured welcome was therefore awaiting the appearance of a new edition. Now it has come it can be commended both for reading and continued reference, to the vast army of technical men to whom the subject is of importance. That means in effect all designers and builders of machinery; all practical engineers desirous of making their prime movers or operating units work most sweetly; all works managers anxious to reduce power and upkeep costs; all chemists and manufacturers dealing with the production of lubricants who wish to keep in touch with the needs of the users of their goods; lubrication experts who wish vicariously to acquire wider experience, and many others. Moreover, the bulk of the book is readable alike by student and salesman. Each can pick from the masses of information and the wise advice freely given something to meet his immediate needs or give him serious food for thought. Thomsen's Lubrication should be in the possession of all those mentioned who can afford it.

Having said that, and before passing to a general description of the book, there are one or two criticisms to offer. Firstly, "all those who can afford it." The cost of production is not known. 36*s*. may be a necessary price to recompense the author and publishers of such a well-finished book. But to the big majority of those for whom it is written and who might become its possessors the price may well prove prohibitive. That is a pity, for the benefits to be derived from its re-reading are likely to be far greater than those from straight-through perusal.

In the second place, the new edition gives somehow an impression in places of patchiness. As though in certain directions it had been "brought up to date" without sufficient welding of the new material into the old and sometimes without sufficient knowledge. Perhaps Mr. Thomsen would have been better to have had a collaborator or collaborators for the revision, especially in view of the vast strides now being made in certain directions and the difficulties of specialization. This suggestion, given now for future consideration, is made in the kindliest spirit, and in the hope that a work held in such great admiration will be maintained as the standard of its kind.

Of the thirty-six chapters, the first six are devoted to theory of lubrication, methods of testing and general description of lubricants. These are adequate for the purpose, though by no means up-to-date. Then follows a long section on bearing lubrication, introduced by one of the best chapters—that on bearings in general. Construction, materials, operating conditions, lubricating systems, and selection of oils are all given consideration. It is here instead of later that attention might be paid to the many views on the grooving of plain bearings. The portion devoted to the principles of ball-and-roller-bearing lubrication is extensive and illuminating, but the reference to greases in this connection is scanty. This is unexpected in view of the present-day attention paid to this form of lubrication with cup, soda-base and lead E.P. greases, and the likelihood of its being greatly extended.

This accounts for approximately one-third of the book. The remainder is given over to the lubrication problems peculiar to individual types of machinery. Thomsen is at his best in those portions devoted to the steam engine and its ancillaries. Steam turbine lubrication is dealt with at considerable length, as is that of stationary horizontal and vertical engines, and marine and locomotive types.

It is not possible within the limits of a review to deal adequately with the amount of detailed information on every aspect of practical lubrication which the book unfolds. To quote only a few of the chapter headings—there are sections on textile machinery (well done), compressors, refrigerating machines, gas engines, diesel engines, steel and tinplate mills (not very well done) and of course the "gasoline engine." It would be poor reviewing to pretend that this last-named important section is dealt with in the manner it deserves or which the general high standard

of the treatise would lead one to expect. With so many sources of information open to consultation, much more could have been done with this essentially modern aspect of lubrication practice.

It is sincerely hoped, and may be reasonably expected, that "Thomsen" will in due course pass into a fourth edition, when its present blemishes will be removed. In the meantime its basic goodness and frequently outstanding merit are sufficient to stamp it as a worthy holder of its unique position.

S. J. M. Auld.

Flow of Homogeneous Fluids. By M. Muskat. Pp. xix + 755. 1937. McGraw-Hill Publishing Co. Ltd., London. 45*s.* net.

The appearance of an outstanding book on the subject of the flow of homogeneous fluids through porous media is long overdue and all who are interested in the problem will welcome it, with considerable pleasure.

The field is a wide one, but up to the present no comprehensive treatment has been available for the benefit of students or for executives possessing little or no knowledge of the subject. Numerous scientific papers have been published in the journals of learned Societies, but these have been in no way complete. Such a work has, therefore, become a necessity, and no one is better qualified to satisfy this need than the author of the present treatise.

It should be made clear that no claim is made for solving the nature of the flow of gas–oil mixtures through porous media. This is to be regretted, as it is really the fundamental physical problem in most actual cases of oil production. May it be hoped that in the not-too-distant future Dr. Muskat may satisfy the need of an authoritative work on the flow of heterogeneous fluids through porous media. Such a work would be highly valuable to students and executives alike.

The work cannot be considered in any way an elementary text-book. It is, in fact, a fairly complete treatise of the subject, and anyone without a thorough knowledge of the calculus and some familiarity with the elements of differential equations will find it impossible to follow all but the initial part which deals with the general theories of the flow of homogeneous fluids through a porous media, in what the author terms "Foundations." Assistance is given to those who are interested mainly in the results and do not desire to follow, or are prevented by reason of a lack of knowledge of the mathematics from following the analytical derivations, by the addition of non-mathematical summaries to each chapter except the first two. These summaries give a clear explanation of the various problems discussed, and point out the salient features of the solutions derived theoretically.

The work is divided into four main parts. The first part is really the foundation upon which the remainder of the work is built. It is essentially non-mathematical, although Darcy's Law and the measurement of permeability of porous media and the general hydrodynamical equations for the flow of fluids through porous media should be understood if a thorough grasp of this section is to be obtained. Anyone familiar with the subject-matter of this section should experience little difficulty even without a thorough knowledge of the mathematics required for the remainder of the work.

The second part, by far the most extensive of the whole work, treats problems of fluid flow in the steady state, the fundamental dependent variable which satisfies Laplace's equation being taken as the pressure rather than the density. Potential–theory methods are applied successively for the solution of two- and three-dimensional problems, gravity flow systems and non-uniform permeability. In several cases actual experiments with sand and electrical models, performed to give results for cases where analysis becomes impractical, are described and discussed.

The treatment of typical cases of non-steady state flow of liquids is given in Part III, and the solutions for typical cases of gas flow are dealt with in Part IV. No claim is made that the discussion of these two phases are dealt with exhaustively.

The work is undoubtedly a valuable addition to the knowledge of the flow of fluids, and if any criticism can be made, it is that no independent lists of references are included at the end of each chapter. The method of appending references at the foot of the page reduces the maximum utility of such references, but this criticism in no way detracts from the value of the work as a whole.

L. V. W. Clark.

Toxicity of Industrial Organic Solvents. Compiled by Ethel Browning under the direction of the Committee on The Toxicity of Industrial Solvents—Report No. 80 of the Industrial Health Research Board of the Medical Research Council. Pp. iii + 382. Index, pp. 383–388. H.M. Stationery Office. 7*s.* 6*d.*

Organic solvents are used on a large scale in present-day industry, and it is therefore of the greatest importance to know which solvents may be harmful to workers in an enclosed space and which are harmless. In the case of possibly harmful solvents it is important to know the conditions under which such solvents can be used freely if the requisite precautions are taken. With regard to new solvents, it would be of great assistance to have an established procedure whereby definite information could be obtained as to the possible toxicity of the solvent before it is taken into use on an industrial scale.

At the request of the Home Office, the Medical Research Council has appointed a Committee on the Toxicity of Industrial Solvents to carry out "a scientific investigation into the possibility of various volatile substances having injurious effects upon the health of workers using them under industrial conditions." In order to assist this committee in their work, Dr. Ethel Browning has made a summary of the existing work on this subject, and this compilation has been published in a form which should be very useful to those interested in organic solvents on an industrial scale. Most of the common organic solvents are dealt with, and useful descriptions are given of their industrial applications and their toxic effect, if any, on animals and on man where this is known.

In the hydrocarbon group of solvents it is pointed out that there is some confusion in the use of the term "benzine" when "benzene" is meant. The author herself defines benzine as "a mixture of varying and uncertain proportions of hydrocarbons (chiefly hexane and heptane), which is a distillate of petroleum." Such a definition is misleading, as in the petroleum-refining industry the term benzine is used to cover all petroleum distillates with varying boiling ranges up to about 225° C., and should only be used, if at all, in this general sense. The volatile petroleum distillate which is marketed for use as fuel in spark-ignited engines should be called motor spirit or petrol in this country, and gasoline in the United States. The distillate fractions of petroleum which are used as industrial solvents could be called "petroleum spirit," followed invariably by the boiling range—thus, "petroleum spirit 90–110° C." It is suggested that such a system of nomenclature would clear up some of the confusion on this subject.

The compiler of this volume cannot be expected to be conversant with all the details of the properties of petroleum solvents of various origins, and such statements as that Roumanian white spirit has the greatest general solvent power (p. 109) must be due to ignorance of the fact that Borneo White spirit has greater solvent power owing to its higher content of aromatic hydrocarbons.

The case of a man becoming unconscious when using a red lead paint in a confined space (p. 109) was attributed to the use of white spirit, but this does not seem convincing in view of the fact that the paint contained 17·29% of oil of terebene and only 2·5% of white spirit.

Apart from some inaccuracies due to a limited knowledge of petroleum technology, this book is a very useful compilation of the information available on the toxicity of industrial organic solvents up to the year 1935. The particularly full list of references given at the end of each subject greatly increases the value of this work.

W. W. GOULSTON.

The Geology and Biology of the San Carlos Mountains, Tamaulipas, Mexico. By L. B. Kellum. Pp. xi + 304. Index, pp. 305–341. University of Michigan Press, Ann Arbor, Michigan. 1937. $5.00.

This book represents the results of the University of Michigan expedition to the San Carlos Mountains (North-east Mexico) in 1930, and contains the following reports:

I. Geology of the sedimentary rocks of the San Carlos Mountains, by Lewis B. Kellum (pp. 1–97).

II. Igneous rocks of the San Carlos Mountains, by Edward H. Watson (pp. 99–156).

III. Ore deposits of the San Carlos Mountains, by Edson S. Bastin (pp. 157–206).

IV. Geology of the Sierra de Cruillas, Tamaulipas, by Ralph W. Imlay (pp. 207–242).

V. Mammals of the San Carlos Mountains and vicinity, by Lee R. Dice (pp. 243–268).

VI. Notes and studies on Arachnida III. Arachnida from the San Carlos Mountains, by Arthur M. Chickering (pp. 269–284).

VII. Two new Tarantulas of the genus Eurypelma from the San Carlos Mountains, by Ralph V. Chamberlin (pp. 285–292).

VIII. Fishes from the San Carlos Mountains, by Carl L. Hubbs (pp. 293–298).

IX. Some amphibians and reptiles from Tamaulipas, by Helen T. Gaige (pp. 299–304).

To the geologists the reports by L. B. Kellum, E. H. Watson, R. W. Imlay and E. S. Bastin are of interest.

The San Carlos Mountains form a *broad gentle arch* at a distance of 25 miles east of the Sierra Madre folds. On this geanticline numerous domes produced by igneous intrustions are superimposed. The *tectonics* of the region are illustrated by excellent maps.

The *stratigraphy* is discussed in considerable detail by L. B. Kellum and R. W. Imlay. The paper by R. W. Imlay contains an interesting table, illustrating the age, Texas equivalents, relationship of formations, thickness and general lithology of the sedimentary formations. Fossils proved that the Tamaulipas limestone ranges from Albian (Uppermost Cretaceous) to Portland (Uppermost Jurassic). 2000 to 3000 ft. of this limestone are exposed in the San Carlos Mountains.

The post-Cretaceous *intrusions* which have taken place at widely scattered localities and at several stratigraphic horizons are represented by two major groups. The older group consists of a series of so-called normal calc-alkalic rocks which range from gabbro and diorite through quartz diorite and quartz monzonite types to microgranites and alaskites. It forms the greater number of laccolitic intrusions, and very few small dikes and sills. The latter group consists of a complicated, very variable suite of uniformly alkalic rocks. This group of intrusions sends numerous offshoots in the form of dikes, sills and plugs into the earlier porphyrics and throughout the stratified rocks. The intrusions of the igneous masses into the Tamaulipas limestone produced contact metamorphism.

The lithology and occurrence of these intrusions are ably discussed by E. H. Watson.

The *ore-deposits* of the San Carlos Mountains, according to E. S. Bastin, lie outside the principal mineralized province of Mexico. It is assumed that the copper ores and the lead-silver ores have been deposited by solutions coming from the magmas of the intrusions. The ores have been found at or near the contacts of diorite or diorite porphyry with limestone. Most of the ores lie in the igneous rocks rather than in the limestones. Many contacts were observed along which there was little or no mineralization.

The structural conditions of the San Carlos Mountains may be of interest also to those geologists studying the south-eastern end of the Sierra Tamaulipas, north-west of Tampico, as this latter arch shows many analogies.

O. Dreher.

BOOKS AND PUBLICATIONS RECEIVED.

Department of Scientific and Industrial Research. Report for the Year 1936–37. Pp. iv + 195. H.M. Stationery Office, Adastral House, Kingsway, W.C.2. Price 3*s*.

The Annual Report of the Department of Scientific and Industrial Research contains, in addition to the Report of the Advisory Council, a summary review of the work carried out under the various research organizations of the Department. Of particular interest is the work of the Research Committee of the Institution of

Automobile Engineers, which has included an examination of the influence of bearing materials, lubricants and operating conditions, and has resulted in the development of a new technique for the measurement of the temperature of bearings on high speed engines. A recent development in the investigations of cylinder wear by this Committee has been the application of a new method of studying the formation of a lubricating oil film on the cylinder walls. Lubrication research has included work on the failure of bearings, experiments with the four-ball extreme pressure lubricant testing machine and an investigation of the physical properties of surfaces.

Annual Report, 1937 of the Imperial Institute. By Sir Harry Lindsay, K.C.I.E., C.B.E. Pp. 71. Imperial Institute, S. Kensington, S.W.7.

The contents of this report include an account of the Scientific Departments dealing with Plant and Animal Products and with Mineral Resources.

Junior Institution of Engineers. Record of Transactions. Volume XLVIII, 1936–1937. Pp. 536. Percival Marshall & Co., Ltd., 13–16, Fisher Street, Kingsway, W.C.1.

Included in the papers read before the Institution are the following :—"Metallurgical Developments and Engineering Progress," Sir William J. Larke, K.B.E. "Elements of Pumping Machinery," B. J. Lymer. "Geodetic Surveying for Map Production," F. B. Lockett. "The Standard Sunbury Cathode-Ray Engine Indicator in Theory and Practice," D. I. McGillewie and J. G. Withers.

The Journal of the Iron and Steel Institute, Volume CXXXVI, No. 11, 1937. Proceedings, pp. xiii + 1P–346P; Abstracts and Bibliography, pp. 1A–306A; Indexes, pp. 1–67. Iron and Steel Institute, 28, Victoria Street, S.W.1.

The first section embraces the Minutes of Proceedings, including twelve papers presented at the Autumn Meeting in Middlesbrough. The second section comprises a survey of literature on the manufacture and properties of iron and steel and kindred subjects.

Aluminium Alloys. Extract From the Book of Dr. Ing. Alfred von Zeerleder. Translated by A. J. Field with a preface by H. G. Warrington. Pp. 178. High Duty Alloys, Ltd., Slough.

The introductory chapter added with the author's permission gives a short description of the rise and growth of the firm, High Duty Alloys, Limited, and the development in response to modern needs and conditions of the Hiduminium R.R. series of alloys produced under laboratory conditions of analytical purity and scientific control. Dr. A. v. Zeerleder's book aims primarily at serving the practical man, and only those aluminium alloys which are used on an important scale are dealt with. As much theory as is necessary for an understanding of the properties of these alloys is discussed. Chapters are devoted to properties and methods of testing, furnaces and furnace operations, casting, sheet rolling, extension and drawing of tubes and sections, forging, press work and spinning.

The Eska Creek Coal Deposits, Matanuska Valley, Alaska. R. Tuck. Pp. 185–214. Pocket Map. U.S. Geological Survey Bulletin 880-D. Superintendent of Documents, Washington, D.C. Price 35 cents.

A high-volatile bituminous coal has been produced in the vicinity of Eska Creek since 1917. The coal occurs in the Chickaloon formation (Eocene) which, in this area, is composed of over 2000 ft. of sandstone, shale, and interbedded coal seams. The Eska conglomerate, more than 1100 ft. thick, overlies the Chickaloon formation. Both the coal-beds and the intervening sandstone and shale, comprising the Chickaloon formation, vary in thickness and composition within short distances. Over twenty coal-beds having a thickness of more than 3 ft. are known to occur. Most of the coal beds are from 3 to 5 ft. thick.

Geophysical Abstracts 88. January–March 1937. Compiled by W. Ayvazoglou. U.S. Geological Survey Bulletin 895-A. Superintendent of Documents, Washington, D.C. Price 10 cents.

Petroleum Refineries, Including Cracking Plants, in the United States, January 1, 1937. G. R. Hopkins and E. W. Cochrane. Pp. 31. U.S. Bureau of Mines Information Circular 6977.

The total number of completed petroleum refineries declined materially in 1936, but the total capacity to produce crude oil and to crack unfinished oils continued to increase. The total capacity of the completed plants on January 1, 1937, was 4,294,881 brls. of crude oil daily.

Sulphuric Acid Extraction Methods for Determining Olefins and Aromatics in Hydrocarbon Oils. Optimum Conditions and Concentrations of Acid. C. H. Fisher and A. Eisner. Pp. 15. U.S. Bureau of Mines Report of Investigations 3356.

Despite the long use of sulphuric acid as a reagent in the determination of olefins and aromatics in hydrocarbon oils such as gasoline, kerosene and neutral oils from coal-tar distillates, there is no general agreement as to optimum conditions and concentration of acid. The purpose of the work described in this circular was to make a general study of this type of analysis, and to investigate the reactions of hydrocarbons under conditions often used in analyses that employ sulphuric acid reagents.

Analyses of Crude Oils From Some of the More Recently Discovered Rocky Mountain Fields. W. Murphy and H. M. Thorne. Pp. 24. U.S. Bureau of Mines Report of Investigations 3358.

Results are given of analyses of crude oils from several of the more recently discovered Rocky Mountain fields and from new producing horizons in old fields.

Properties of California Crude Oils. V. Additional Analyses. E. C. Lane and E. L. Garton. Pp. 21. U.S. Bureau of Mines Report of Investigations 3362.

This paper includes a short discussion of results, tabular data and individual analyses of sixteen California crude oils.

Explosion in School Building at New London, Texas, March 18th, 1937. By D. J. Parker, G. W. Jones, H. B. Hill and G. Wade. Pp. 29. U.S. Bureau of Mines, Report of Investigations 3365.

An account is given of the enquiry into the origin of the explosion at the New London, Texas, school which caused the death of 280 pupils and 14 teachers.

It was concluded that the immediate cause of the disaster was the ignition and resulting explosion of a large volume of high-explosive natural gas–air mixture that had accumulated in an inadequately ventilated space beneath the first floor of the main school building. Liquid hydrocarbons such as crude petroleum and gasoline, and their vapours from surrounding wells and pipe-lines were not responsible for the explosion.

Co-operative Fuel Research Motor Gasoline Survey, Summer 1937. Compiled by E. C. Lane. Pp. 57. U.S. Bureau of Mines. Report of Investigations, 3374.

This survey of motor gasoline sold to the general public through service stations in marketing areas throughout the United States during the summer of 1937 is the fourth that has been published pursuant to a co-operative agreement between the Bureau of Mines and the Co-operative Fuel Research Committee.

Characteristics of regular-price, premium-price, and third-grade motor gasolines are reported, based on inspections made in oil-company laboratories and submitted to the Bureau of Mines for compilation and comment.

The data of this survey are similar to corresponding figures reported in the survey for the summer of 1936. In general, no definite tendencies in change of

characteristics are evident. The four surveys in this series indicate that gasolines in the various price classifications fall into definite groups with respect to the characteristics reported in the surveys.

NEW PUBLICATION.

Petroleum Technology. Vol. No. 1. February 1938. 9 × 6 ins. Published quarterly by the American Institute of Mining and Metallurgical Engineers, inc. Subscription price $4.00.

This periodical is the medium through which the American Institute of Mining and Metallurgical Engineers effects initial prompt distribution of Technical Publications sponsored by its Petroleum Division. The contents of the annual volume of the Transactions of the A.I.M.M.E. relating to the work of the Division will be chiefly selected from papers that appear in this publication.

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Geology.

474. Geology of the K.M.A. Field. C. F. Dally. *Oil Gas J.*, 20.1.38, **36** (36), 47, 56, 58.—The K.M.A. structure trends N.E.–S.W. and lies between the Red River Uplift and the Bend Arch. Local divergences from the main trend are thought to be due to structural adjustments between these two major uplifts. Few wells have been drilled to the deep oil zone, but it seems that there is little structural relationship between this and the shallower producing horizons.

Opinions on the age of the deep producing horizon are divided: some place it in the Strawn Series, others in the Bend Series. It is a limestone series with interbedded lenticular sands about 300 ft. in thickness. If the producing horizon proves to be of Strawn age, it is expected that further discoveries will be made in other fields in this region; but if it is included in the Bend Series, this possibility is considerably lessened. J. A. G.

475. Two Ordovician Tests May Open West Texas Fields. M. Tucker. *Oil Gas J.*, 3.2.38, **36** (38), 12, 13, 24.—Several wells recently drilled in this region have proved that the structures present in the Permian do not continue down into the Ordovician. Nearly all the production from the Permian is associated with folds along the edges of the basin, but the Ordovician appears to be faulted, and some of the structures are probably associated with deep-seated igneous intrusions. The major structural movements in this area took place in Pennsylvanian times, and therefore the Permian beds are not involved.

At Big Lake, wells passed through about 600 ft. of Pennsylvanian and a thin section of Silurian before entering the Simpson, but at Sand Hills the Permian rests directly on the Simpson. The Ellenburger, a dolomitic limestone, underlies the latter, and is responsible for most of the Ordovician production, although a little oil is found in the Simpson. J. A. G.

476. Geology and Petroleum Development of the Western Kentucky Basin. G. R. Wesley. *Oil Wkly*, 10.1.38, **88** (5), 18–21.—It is presumed that in this area the Ordovician unconformably overlies the basement complex and is followed by 100–1150 ft. of Silurian and Devonian deposits. The Mississippian begins with a shale series, which gradually becomes more calcareous upwards, finally grading into limestone. A period of folding and erosion then took place, and the Chester Series at the top is very lenticular. The overlying Pennsylvanian is more than 2800 ft. in thickness, and consists mainly of shales, sandstones and clays, with occasional thin beds of coal and limestone.

The gradual structural rise from the bottom of the basin in Eastern Illinois is broken by the Rough Creek Anticline which trends east to west, and divides the Western Kentucky portion of the basin into two parts. This fold is faulted and overthrust from the south, the displacement of the main fault varying up to 1000 ft. It is flanked on the south by a highly folded basin, the northern limb of which dips very steeply, the southern limb, which is more gentle, terminating in a series of faults. A little metamorphism has accompanied these structural movements, but it is not sufficient to affect oil accumulation to any great extent.

Few wells have been drilled below the top of the Mississippian, and it is expected that important discoveries will be made when the deeper portions of the basin are tested. J. A. G.

477. Recent Oil Discoveries in South-Eastern Illinois. T. Wasson. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 71–78.—The new oilfields are about 30 miles distant from the old fields of Clark, Crawford and Lawrence Counties. Discovery wells were completed in Wayne, Clay and Richmond Counties in March and July 1937.

Oil has been found in five separate areas in a belt over 20 miles long, extending from Cisne (Wayne Co.) to the new area north-east of Noble (Richland).

Production has been obtained from the McClosky horizon, an oolitic limestone at the top of the St. Genevieve (Mississippian). The thickness of the oil-saturated section varies up to 15 ft. in the best wells. The McClosky itself is found at 2950 ft. in the Clay City and Noble areas, and at 3070 ft. at Cisne.

The section drilled in the new area is similar to that in the south end of the old field, excepting for greater depths and increased thickness. Data, including a correlation chart, are given of the formations so far drilled—viz. St. Genevieve, Chester and Pennsylvanian.

The Chester section from Cisne to Noble shows very clearly the prominent unconformity at the base of the Pennsylvanian. From subsurface work also it appears that the Chester may be divided into zones based on its micro-fossil content; these zones agree fairly well with the subdivisions of this formation established by Stuart Weller.

The paper concludes with a reference to the possibilities of production by deeper drilling in the new area. G. S. S.

478. Medina and Trenton of Western New York. C. A. Hartnagel. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 79–99.—This is a brief account of the stratigraphy, together with the history and development, of the Medina and Trenton gas-fields.

Two main subdivisions of the *Medina* (Silurian) are recognized: the Albion Sandstone (the upper member), approximately 100 ft. thick, and the Queenston Shale (lower member), nearly 1000 ft. thick.

The Albion Sandstone is the most widespread gas-bearing formation in the State. At the top occurs the "Gray band" or Thorold Sandstone, and at the base the Whirlpool Sandstone, which usually marks the lower limit of the gas horizons of the Medina. Other than a few structural terraces on which certain of the Medina gas-fields are located, no important anticlinal structures have been proved. The counties bordering Lake Erie contain the most prolific fields, and although the flows are only moderate, they have proved profitable owing to their long life and favourable conditions for transporting and marketing the gas.

The type section of the *Trenton* (Ordovician) occurs in New York State at Trenton Falls. Predominantly a limestone, the Trenton also contains many beds of shale and sandstone.

The total number of Trenton wells drilled in the State is 334. Of these only the counties of Oswego (165 wells), Onondaga (66), Oneida (50) and Lewis (10) produce gas in commercial quantities. The Pulaski field (Oswego Co.), a type locality, is described in detail.

Little hope is entertained of developing large gas-fields near the eastern end of Lake Ontario. In other sections of New York where the Trenton occurs at depth, tests have been made with disappointing results.

Much of Western New York remains untested, but on the results obtained in fields already developed, prospects of discovering an important gas-field in the deep Trenton are not encouraging. G. S. S.

479. Geological History of the East Indies. J. H. F. Umbgrove. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1–70.—This paper summarizes in a series of sketches the available information relating to the geological history of the East Indian Archipelago. It consists of four chapters:—

I. Palæozoic. The distribution and facies area are described, and reference is made to the Island of Letti, Central Sumatra and Malaya. The rocks are mainly Carboniferous–Permian in age, and in places occur in great thickness. In Letti the Permian is at least 5000 metres thick, while in Malaya an extensive series of volcanic rocks (Pahang Volcanic Series) occurs which range in age from late Carboniferous to Triassic.

II. Mesozoic. Triassic, Jurassic and Cretaceous deposits of the western and eastern parts of the Archipelago are described and illustrated by maps and tables. In the eastern part five types of facies of the Triassic can be distinguished from Timor. The islands of Ceram and Boeroe also contain rocks of Upper Triassic age, and from Western Ceram a thickness of at least 1000–2000 metres is recorded.

Of the Jurassic and Cretaceous deposits data are given concerning the geosyncline of Timor–Eastern Celebes, Soela Isles, Obi and New Guinea. These data are followed by a summary of the Mesozoic history, accompanied by a map and table.

III. Cenozoic. A series of maps and seven sections are included in this chapter. Summaries are given of the stratigraphy, tectonics, etc., of the Tertiary deposits, together with data on Upper Neogene batholithic intrusions, and the origin of deep-sea basins of the eastern half of the Archipelago.

IV. This chapter deals with the question as to whether the zones distinguished in the East Indies can be continued outside this area. For this purpose the author discusses a continuation into the Asiatic continent, especially into Burma. Three areas in Burma are mentioned: (1) The Shan plateau and southward up to Tenasserim; (2) the so-called Central belt of Burma; and (3) the Arakan Yoma, bounded on the west by the basin of Assam.

Lack of sufficient detailed knowledge does not enable one at the moment to follow the East Indian zones beyond Burma to Western Asia and Europe. Nevertheless, the few facts that are available justify the conjecture that this will, in future, become possible. G. S. S.

480. Search for Oil in the Dahalac Archipelago in the Red Sea. L. Maddalena. *Riv. ital. Petrol.*, 1937, **51**, 4–6.—The Dahalac archipelago comprises more than 120 small islands off the coast of Eritrea, extending from Difneim in the north to Bullissar in the south; while on the Arabian side of the Red Sea there is the analogous, symmetrically placed archipelago of Farisan. The tectonic history of the area is discussed.

Oil shows have been noticed since 1868, mostly from the sandy sea bottom. Samples more recently collected showed a specific gravity of 0·890. In 1921 a boring was made on Bullissar, which, after having traversed 110 metres of coral limestone, penetrated a clayey marl with interbedded Miocene gypsum. It is considered likely that the oil shows may be connected with the tectonic lines of the area, indicating the possibility of petroleum deposits along the whole archipelagic platform.

The A.G.I.P. have carried out work in the area since August 1935, resulting in the following stratigraphical divisions being classified:

(1) Calcareous limestone: porous, with many mollusc and coral remains and probably of Pliocene age.

(2) Siliceous tufa; this lies unconformably on the limestone, and while not all contemporaneous, is considered as typically Quaternary.

(3) Varied alluvial deposits, with some gypsum.

Examination of the faults present leads to the conclusion that the tectonic forces were tensional rather than compressional. Structural hypotheses are considered in detail, and it is concluded that there is a salt-mass buried beneath the limestone and that the region may become of great importance as an oil producer.

The programme of exploration approved in March 1936 included the execution of aerial photographs and palæontological, geophysical and geological research. By August of that year the geophysical work had located the site for the first boring, which was begun in the following month, and by January 1937 had reached a crystalline salt-mass at a depth of 300 metres. E. N. T.

481. Shows of Gaseous Hydrocarbons on the Paduan Plains. A. Scicli. *Riv. ital. Petrol.*, 1937, **51**, 7–14.—The internal legislation towards Italian self-sufficiency has resulted in the search for gaseous hydrocarbons which may be compressed into cylinders and used as vehicular propellants.

Attention has in the past been mainly focused on the Apennines, but the author considers that the Paduan plain, which has been neglected until now, should be thoroughly examined in view of the ease with which gas may be transported from there.

Previously only water wells were drilled in this region, and when gas was encountered the well was abandoned, or at most the gas locally used. Large quantities, which often continued to flow for a considerable time, have thus been wasted.

The gas may easily be separated from emulsion with water, and analyses show that its combustibility is very little less than that of the Apennine variety, although containing slightly more nitrogen.

The geological conditions of the gas-bearing strata are briefly considered, and the

history and geography of the various shows are comprehensively dealt with. The gas zones vary in depth from 15 to 200 metres, occasionally being even deeper. Most shows occur in the provinces of Reggio Emilia, Modena, Rovigo, Ferrara and Ravenna; there is also some gas in the neighbourhood of Venice, but apparently none in Piedmont.

Finally the gaseous emanations in connection with thermal waters are described.

E. N. T.

482. Oilfields of the U.S.S.R. W. J. Komnitzer. *Oil Gas J.*, 20.1.38, **36** (36), 103–108; and 3.2.38, **36** (38), 83, 84.—Production in the Caucasus region is mostly obtained from the Azerbaidjan district, which includes the Apsheron Peninsula. The basement rocks of the main Caucasus Range are successively covered south-eastwards towards the Peninsula by Jurassic, Cretaceous, Tertiary and Quaternary deposits. The folding in these sediments is generally N.E. to S.W., but there is a tendency for the folds to branch locally, and even to form ring-shaped structures. Oil accumulation has been strongly influenced by the complicated nature of the structures and lateral variations in the lithology of the producing horizons. Production is mainly from the Pliocene and to a smaller extent from the Miocene and Oligocene. The beds thicken towards the east and south and the Cretaceous may be oil-bearing in this direction.

The Kura Plain, which lies to the S.W. of the Apsheron Peninsula, is being prospected by geophysical methods, and many buried structures are indicated. Of the three fields which have been discovered, Pirsagat is the most important, and production comes from immediately below the Akchaghylian Series at a depth of about 3765 ft.

In the N.E. Caucasus region Tertiary sands and clays overlie Cretaceous limestones, and the folding is generally consistent with the main Caucasian trend. Overthrusting and faulting complicate many of the folds, and they usually have steep limbs with the Tertiary beds highly compressed in the cores of the structures. Production is from Lower Miocene sands totalling more than 500 ft. in thickness.

In the Kuban and Azov–Black Sea district, Maikop is the most important field, and produces from Oligocene and Miocene sand lenses which are said to be buried stream channels or shore-lines. The regional structure is generally monoclinal with the sands thickening down dip, and further developments are expected in this direction.

J. A. G.

See also Abstract No. 493.

Geophysics.

483. Demarcation of Oil Concessions by Geophysical Methods. O. Barsch. *Oel u. Kohle*, 1937, **13**, 1213.—The author stresses the economic advantages of delimiting oil concessions according to the form of the actual underground structures rather than by geographical or arbitrary boundaries. The chief aim of this method, of which two examples are illustrated, is to confine each potential oil-bearing area as far as possible to one concession.

P. G. H.

484. Radio Prospecting. Representation of the Properties of the Geological Conductor. V. Fritsch. *Beitr. angew. Geophys.*, 1937, **6** (4), 407–412.—The properties of the geological conductor (a rock considered from the electrical viewpoint) can vary between very wide limits. Whilst properties such as the dielectric constant and conductivity may be represented by a point in the case of a simple substance, a line is needed on the same scale to represent the geological conductor. Thus there is overlap between the properties of various rocks. Furthermore, these properties are altered by variations in frequency, so that a three-dimensional diagram is needed for their representation.

The dielectric constant and conductivity also vary with rock texture and the concentration of aqueous solutions in the rock. A series of diagrams may therefore be prepared, and the use and significance of these are discussed.

These diagrams apply only in the case of a single-layer problem. Where there are several strata, one above the other, the diagrams can be applied only when certain of the properties are held constant. The possibility of this needs special investigation.

S. E. C.

485. Uniformity in the Representation of Magnetic Measurements. F. Bahnemann. *Beitr. angew. Geophys.*, 1937, **6** (4), 413–416.—Uniformity is to be desired when assigning a positive or negative sign to a magnetic anomaly. The decision should be based on the definition of the direction of the earth's magnetic field, which, according to Jeans, is, "the angle between the line of magnetic force and the horizontal is to be reckoned positive if the line of force points down to the earth." Thus in the case of a body lying parallel to the direction of the earth's field, a positive disturbance would be observed at the earth's surface in regions north of the magnetic equator and a negative disturbance in regions south of the magnetic equator. S. E. C.

486. Value of Shot-Point and Short-Distance Geophones in Seismic Prospecting. V. G. Gabriel and R. M. Wilson. *Oil Wkly*, 7.2.38, **88** (9), 14–17.—Let x be the thickness of the weathered zone at the shot point and y the depth of the shot point below the base of the weathered zone. Let V_w and V_s be the velocities of propagation of the longitudinal waves in these layers, respectively. Then if H is the total depth of the shot and T the travel time to the shot-hole geophone,

$$x = \frac{V_w(V_sT - H)}{V_s - V_w} \text{ and } y = \frac{V_s(V_wT - H)}{V_w - V_s}.$$

For a geophone 100 ft. from the shot point let X be the length of the wave-path in the weathered zone, L the length of the path in the underlying high-velocity medium, V_w and V_s the corresponding velocities of wave propagation, and T the travel time, then

$$X = V_w\left(T - \frac{L}{V_s}\right).$$

In practice for weathered zones not over 50 ft. thick, X may be taken as equal to the thickness of the weathered zone at the geophone 100 ft. from the shot point. The results of tests show good agreement with these formulæ, and indicate that the paths in the first high-velocity layer for short distances are straight lines. G. D. H.

Drilling.

487. Faster Side-tracking Achieved by Use of Hard-faced Mills. Anon. *Oil Gas J.*, 10.2.38, **36** (39), 48.—To reduce the expense of side-tracking to a minimum, mills with long, efficient cutting life are necessary. These mills are almost always hard-faced, with an extremely wear-resistant alloy.

A whipstock almost 12 ft. in length is the usual method adopted. This is cemented firmly in place, and since the whipstock is of heavy material, the mill is forced to cut its way through the casing.

The method of hard-facing these mills is given in detail. L. V. W. C.

488. Resistance of Seamless Tubular Materials Against Collapsing Pressures. F. G. Tebenszky. *Oil Gas J.*, 3.2.38, **36** (38), 42.—A consideration of the factors bearing on the success of deep-well drilling involves a discussion of the pressure that will be exerted by a water column surrounding the coupled drill-pipe sections when there is no water column of equal weight on the inside of the tube. If the load reaches the critical external pressure, the pipe will collapse. The author gives a chart and two nomograms for discussing the critical external pressure when the relation of the wall thickness to outside diameter is known. L. V. W. C.

489. Deep-Drilling Trend. L. J. Logan. *Oil Wkly*, 7.2.38, **88** (9), 22.—This is a *résumé* of deep drilling, together with tables of all wells drilled below 10,000 ft., with the necessary statistics. L. V. W. C.

490. Drilling Past 13,400 Feet. L. P. Stockman. *Oil Gas J.*, 24.2.38, **36** (41), 65.—A new depth record has been established in the Wasco district of Kern County, California. This well has reached a depth of 13,460 ft., and has also annexed the record for the second longest string of 7-in. casing ever set. It is the first wildcat to reach

a depth in excess of 13,000 ft., and it is the intention of the Continental Oil Co. to continue to 13,500 ft.

Drilling operations were carried on with ease, and, despite fast footage, the hole remained straight. Maximum deviation from the vertical was only 22·1 ft., and the last survey taken at 11,573 ft. indicated that the bottom of the hole was almost directly beneath the derrick.

The string of 7 in. landed at 11,573 ft. consisted of 30 lb. extreme line casing and required only 8 hours and 20 minutes to run in and land the entire string. The cement job was completed in less than 2 hours using high-temperature oil well cement.

72 bits and 49 core bits were used in drilling this hole.

A full description of the well is given. L. V. W. C.

491. New Depth Record. W. A. Sawdon. *Petrol. Engr*, Feb. 1938, **9** (5), 41.—A well in the San Joaquin Valley has reached a depth of 13,154 ft., and there seems to be a good prospect of obtaining commercial production. This is strictly a wildcat well. No special equipment has been used in drilling this well, but modifications to meet the demand of the record applications were designed.

A description of the well is given. L. V. W. C.

492. Progress in Engineering. B. Mills. *Oil Wkly*, 7.2.38, **88** (9), 32.—This article details the advancements made in exploration, drilling, production and pipe-line practices, and equipment during 1937, and suggests that further progress will be made during 1938. L. V. W. C.

493. Prospective Drilling. W. Tiraspolsky. *Bull. Ass. franc. Tech. Petrol.*, 1937, (40), 16–33.—Methods of examination applied to the samples obtained in the drilling of test holes are reviewed. The object of such borings is to furnish information on the tectonics and constitution of the sub-surface strata. In view of the cost entailed, such information should be as complete as possible.

Apart from the hydraulic rotary methods, the cable-tool technique is the only one suitable for this work, although various shot and diamond-drilling devices are also utilized. Choice of bit diameters, orientation and deviation measurements are all essential controlling factors. Lithological samples can be obtained from the mud-flush if due precautions are taken, but more reliably from cores which may be obtained by a variety of devices. The physical nature of such samples must be examined immediately they are obtained, and tests are commonly applied for the following features: porosity, permeability, specific gravity, colour, hardness; mineralogical, petrographical and palæontological nature; presence of gas, oil or water; and more rarely hardness, grain size, electrical conductivity and radioactivity. Information can in this way be obtained regarding the character of the strata pierced, the mud equilibrium and the possible productivity of the area. Electrical coring is now often utilized and by similar methods geothermal gradients may be obtained.

E. N. T.

494. Chemical Treatment of Trinidad Drilling Fluid. I. McCallum. *J. Instn Petrol. Tech.*, 1938, **24**, 1–15.—A paper, with discussion, describing experiments with two basic forest clay muds, loaded with barytes, in which the relative effects on viscosity and gel strength by sodium silicate solution and by quebracho–caustic soda solution were investigated. G. R. N.

495. Recent Advances in Colloidal Properties of Clay Suspensions and Gels. Part II. C. E. Reed. *Petrol. Engr*, February 1938, **9** (5), 62.—The most convenient method of characterizing the size of small particles lies in a determination of their settling rates. In general, the greater the mass of a particle of given shape, the greater its settling velocity, whilst a particle of given mass will settle at different velocities depending on its shape.

A clay will, in general, contain particles of variable size, and it is important to know the proportions of the samples represented by the different sized particles.

A sample of Wyoming Bentonite was subjected to a series of centrifugal fractionations, and a particle-size distribution curve was obtained. This is given. All fractions

analysed the same chemically, and all had the same equivalent weight of approximately 1000.

The important colloidal property of interest in these systems is the rate at which a given sol will increase in viscosity and transform itself into a gel. When a clay sol sets to a gel, the mechanical properties of the gel continue to undergo a change towards some limiting value that would be approached were the gel allowed to stand indefinitely. L. V. W. C.

496. Automatic Sampling of Drilling Mud Achieved by New Device. L. G. E. Bignell. *Oil Gas J.*, 17.2.38, **36** (40), 57.—A mechanical device for sampling drilling mud and a sampling machine which detects quickly and accurately slight showings of gas or oil have been developed.

This sampling device is placed in the mud ditch a short distance from the discharge pipe leading from the well-head. The stream flows through the base of the sampler and turns the wheel to which the sample cutter or spoon is attached. The spoon scoops up a load of mud and cuttings, and, after washing, the cuttings fall into a nest of laboratory screens.

A sample of the return mud and cuttings is obtained automatically and, using duplicate pans and screens, it is possible to remove mud and cuttings and to test the mud for changes and the cuttings for showings of gas or oil. Coring can thus be avoided. Electrical coring has shown that small showings of gas and oil have been detected with accuracy.

To test for oil two methods have been developed. One method requires the taking of a 100-c.c. sample of the mud and adding 20 c.c. of benzole. The mixture is shaken, centrifuged and the benzole decanted into 1-oz. bottles. The benzole samples are set aside in the order taken, and the last one taken is compared with the previous ones and colour changes are noted. A darkening of the benzole cuts is shown when drilling an oil sand. This is a sensitive test, and shows small traces of oil.

The second method of testing for oil showings is adapted to the detection of light-gravity oils in mud which has already been contaminated. A 1000-c.c. sample is centrifuged, and the oil appears at the top as a thin rainbow.

To detect gas a special apparatus has been developed. The sample is poured into the lower half of the apparatus, a flask is filled with distilled water and the upper half of the apparatus inserted. More distilled water is added if necessary through a graduated tube to bring the level up to the zero mark. A vacuum of about 600 mm. Hg is then applied to the top of the tube. The height of the liquid in the graduated tube is read and corrected to atmospheric conditions. From the reading in the tube and the difference between the vacuum and barometric recordings it is possible to determine the gas in the mud. L. V. W. C.

497. Patents on Drilling. J. C. Conrad. U.S.P. 2,103,235, 28.12.37. An instrument for photographically indicating the deviation of boreholes.

J. H. Howard. U.S.P. 2,103,583, 28.12.37. Well reamer.

A. C. Catland and P. C. Effromson. U.S.P. 2,103,611, 28.12.37. A core catcher for use in a tubular well drill.

R. B. Kinsbach. U.S.P. 2,103,622, 28.12.37. A side-tracking apparatus comprising a whipstock having a tapered face, a milling tool with guide to permit tool to be moved laterally as it slides downwards.

G. F. LeBus. U.S.P. 2,103,988, 28.12.37. A knuckle-joint for well-fishing tools. L. V. W. C.

Production.

498. Production Characteristics of California Flowing Wells. E. G. Trostel. *Oil Gas J.*, 17.2.38, **36** (40), 50.—The chief expulsive force in driving the oil out of the sand to the well bore is shown to be natural gas when the characteristics of oil and gas reservoirs are reviewed. Maintaining a maximum amount of this gas in the reservoir as withdrawal takes place is the ideal to be aimed at if production costs are to be kept at a minimum and economical recovery at a maximum.

The most important means of maintaining a low gas–oil ratio are found to be in

positive exclusion of free gas, producing at an optimum rate and tubing wells deep. Gas injection and repressuring assist recovery from an oil reservoir, and the selection of the tubing string to minimize friction and slippage losses enables a proper utilization of gas energy to be obtained. The requirements can usually be met by a uniform tubing string of standard size. L. V. W. C.

499. Hydraulic Principles Used for Pumping. Anon. *Oil Gas J.*, 24.2.38, **36** (41), 194.—The latest development in hydraulic pumping has been the use of multi-well installations in which a whole lease or group of wells can be operated as a unit by means of a central hydraulic power-plant and individual subsurface hydraulic pumps.

Central hydraulic power plants pump clean oil through stationary pipe-lines and tubing to the bottom-hole pumps, where it serves as a power fluid. Each pump is independently controlled to suit individual producing conditions. Existing control installations serve wells up to 8300 ft. in depth, with individual production ranging from a few barrels to 860 brls. per day.

The units are described in detail. L. V. W. C.

500. Use of Hydraulic Pumps in Mid-Continent Fields. J. F. Crawford. *Oil Gas J.*, 24.2.38, **36** (41), 81.—Except for the Oklahoma City field, where there are some 52 installations, hydraulic pumping in the Mid-Continent is still in its infancy. Those in the Oklahoma City field consist of 1 4-in., 5 2½-in. and 46 3-in. pumps. Training the personnel to the point where pumps can be operated to the best advantage has required considerable time.

Hydraulic lifting costs have been on at least an equal basis with other pumping methods, and in some cases have shown decided advantages. The cost of equipment and installation of a 3-in. pump equipped with gas-engine drive is approximately $11,000, including both strings of casing. L. V. W. C.

501. Oil-Well Casing-pumps Finding Widespread Applications. Anon. *Oil Gas J.*, 24.2.38, **36** (41), 159.—At the present time more than 500 casing-pumps are in service. The casing-pumps of the two principal designs consist of a specially designed packer, which seals off against the casing by means of an expanding head, below which is the conventional working barrel with standing and travelling valve. The whole assembly may be anchored at the desired depth by one of several means. Originally the application of casing-pumps was somewhat restricted to wells where casing had been run to or below the desired pump position. An advanced method of setting packer and extending tubing with working barrel on bottom down into the open hole as far as conditions require has removed this limitation. The expanding packer is made of a synthetic product which is chemically inactive with oil and will not adhere to casing or expanding head. After the pump is anchored, the submerged polish rod operates through a stuffing-box at the pump-head just above the packer. The pump assembly itself remains stationary, the only motion being that of the travelling valve near the base of the assembly.

Two important factors in the lifting of oil-well fluids work to the advantage of casing-pumps in keeping down loads at the polish-rod. First the ratio of frictional area to total fluid being lifted in, say, $5\frac{3}{16}$-in. casing is much less than the ratio of frictional area where the same fluid is passing between the same size rods inside 2½-in. tubing. Second, in fluid columns where this ratio of frictional area is reduced and larger-diameter columns are permitted, the natural energy from the well itself is permitted to act more efficiently, and results in a higher fluid level, with accompanying reductions in the lifting load.

These two factors result in polish-rod loads and required pumping horse-powers being somewhat lower than those recorded on tubing-equipped pumping wells. As a general rule, pumping cycles may be reduced when using casing-pumps without sacrifice of volumes lifted. L. V. W. C.

502. Deep Pumping Wells. E. Boaden. *J. Instn Petrol. Tech.*, 1938, **24**, 112–123.—A paper read at the I.P.T. Rumanian branch, covering pumping equipment, estimation of available fluid to be pumped, pumps, plunger sizes, loads and dynamic loads, tubing anchor, gas anchor, polish-rod fitments, paraffin deposits and economies in pumping lease operations. G. R. N.

503. Dual Manifold, More Flexible Control. F. B. Taylor. *Oil Wkly*, 7.2.38, **88** (9), 47.—An unusual production manifold arrangement permits crude from the entire lease to be handled and provides more flexible control.

Nine wells produce into the manifolds. The headers are parallel with 45° connections, allowing a very sightly job with accessibility to valves assured. A Y connection joins the headers midway between the two sides of the manifold, and is buried beneath the surface. Each header is about 30 ft. in overall length and 6 in. in diameter. The units are supported in concrete forms about 3 ft. above ground. The lead lines are 4-in. pipe. Two separators are directly connected to the headers, and all production passes through them in whatever proportion desired by the operator by means of the by-pass connecting the two sides of the manifold. L. V. W. C.

504. Methods of Cementing Wells to Reduce Gas–Oil Ratios. W. A. Sawdon. *Petrol. Engr*, Feb. 1938, **9** (5), 66.—A technique has been developed for the exclusion of gas from the upper part of the producing zone, whether there is a parting between the oil and gas strata or the gas is coming from the upper part of the oil zone itself. Reduction of the gas–oil ratio has resulted from cementing by the squeeze method.

The usual practice now followed is to place the cement through a cement retainer at pressures of 2000 to 3600 lb. per sq. in., although at one well a pressure as high as 5600 lb. per sq. in. was used.

A number of examples of squeeze jobs are given. L. V. W. C.

505. Inexpensive Reconditioning of Oil Wells. Part I. H. E. Winter. *Petrol. Engr*, February 1938, **9** (5), 115.—Many factors must be considered before deciding to repair a well. Operators have obtained very profitable results after an economic consideration of these factors by stimulating production, shutting off water and plugging back to upper zones.

The success of the actual repair job depends on the crew doing the work. Attention to details and careful measurement are imperative, and the crew must realize the importance of their work.

The two-working drum portable hoist has been found most desirable for repair work. A portable sand reel can be set between the samson post and the hole when the well is equipped with a steam or single-cylinder gas engine or electric motor driving a band wheel for pumping. Where a rotary draw-works is available, the portable sand reel can be installed in front of the rotary drum to make a two-drum hoist.

Where the perforations are clogged, swabbing is the simplest and cheapest method. Perforation cleaners are available. One operates by means of a suction that varies with the hydraulic head of the fluid in the well. Another type of cleaner operates by means of a plunger or piston action that forces fluid outward through a number of perforations isolated by swab cups.

Heaving plugs are used to overcome sand trouble. Care must be taken to make sure that the bridge plug will go down the liner, as its failure to do so will necessitate its being drilled up. The simplest method is to clean the hole carefully, and dump a sack of cement on bottom or to fill the hole until the cement extends up into the liner approximately 3 ft.

If the liner is worn or wire cut and the possible increase in production does not justify rigging up to insert a new liner or to re-drill, a small liner can be set. The inside liner should have plenty of perforations, and should be brought up above the old liner and a new adapter set in the water string. A few gun perforations will insure that some holes line up if sand packs between the liners. L. V. W. C.

506. Tomball Blow-out—Fourth Well Out of Control in District. N. Williams. *Oil Gas J.*, 3.2.38, **36** (38), 25.—Four wells are now out of control in Tomball field, South Texas. The fourth well blew out whilst the drill-pipe was being pulled, although the depth of the hole was only 2364 ft. Surface casing prevented the well from caving, and although a considerable volume of gas is being produced, the well has not fired. Little trouble is contemplated in capping the well unless it craters.

The other three wells which have got out of control in this area are much deeper, and despite the drilling and relief wells, it has been found impossible to control them. L. V. W. C.

507. Burning Gas Well Resists Control. B. Smith. *Petrol. Engr*, Feb. 1938, **9** (5), 44.—Efforts to extinguish and bring under control the cratered well in the La Blanca field, Texas, have so far been unsuccessful, although fire fighters have been busy since January 9th. L. V. W. C.

508. Patents on Production. C. L. Coshow. U.S.P. 2,103,236, 28.12.37. Sucker-rod stabilizer.

R. A. Mueller. U.S.P. 2,103,431, 28.12.37. Means for controlling flowing wells.

B. E. Lindsly. U.S.P. 2,103,475, 28.12.37. Apparatus for taking samples of fluid from a well.

J. B. Kitchell. U.S.P. 2,103,586, 28.12.37. Tubing head.

W. H. Stigall. U.S.P. 2,103,601, 28.12.37. A withdrawable sucker-rod assembly.

A. H. Fletcher. U.S.P. 2,103,840, 28.12.37. A well tester for use on a test string. L. V. W. C.

See also Abstract No. 492.

Transport and Storage.

509. Soil-Corrosion Studies, 1934. Bituminous Coatings for Underground Service. K. H. Logan. *Bur. Stand. J. Res. Wash.*, 1937, **19**, 695–740.—This paper summarizes the results of experiments started between 1922 and 1930, and which represent pipe-coating practice at that period. The most commonly used coatings are made from bituminous materials from two general sources: coal-tar pitch and petroleum asphalt.

As to structure, the bitumen coatings can be classified as dips and cutbacks, unreinforced coatings, enamels and fabric reinforced or shielded materials.

The performance of these coverings is controlled by the soil conditions, of which the shrinkage and relative density are important factors in the distortion of coatings.

Although no method or material tested completely prevented corrosion under all soil conditions for as long as four years, nearly all of them greatly reduced loss of metal during the period of the test.

Coatings which are somewhat porous, *e.g.* cutbacks and asphalt emulsions, are effective in preventing pitting in well-aerated soils. However, for severe soil conditions thin coatings are unsuitable, and the thickness of the covering becomes an important factor.

For the same thickness, coal-tar base coatings absorb less water and have better insulating qualities than those having an asphalt base. On the other hand, the former are usually more severely affected by soil stresses, sudden changes in temperature and shocks than the asphaltic material.

Shields and reinforcements reduce the depth of the deepest pit during the first few years of exposure, possibly because of the relatively great thickness of this type of coating.

The conclusion is reached that no bituminous coating or coating material is inherently greatly superior to all others, and it is possible to secure similar results by several methods. D. L. S.

510. Steel Balloons and Vapour-Gathering Systems. C. B. Hull. *Refiner*, 1937, **16** (9), 407.—A short discussion of the application of the balloon principle in closed vapour systems to the refined gasoline storage at several of the refineries of the Continental Oil Co. Comparison of gasoline storage, pumping and loading loss before and after this system was installed showed a saving of 0·55% for a period of four years. G. R. N.

See also Abstracts Nos. 492 and 534.

Crude Petroleum.

511. Properties of California Crude Oils. V. Additional Analyses. E. C. Lane and E. L. Garton. *Bur. of Mines*, R.I 3362, Dec. 1937.—The physical and chemical properties and yields of major products according to the Bureau of Mines (Hempel)

distillation method are given of the following 16 Californian crude oils: *Kern County*—Edison (2), Midway (light), Mountain View, North Belridge, Greeley and Ten Section; *Kings County*—Kettleman North Dome (4); *Los Angeles County*—Del Rey, Fruitvale (2) and Wilmington (2). C. L. G.

512. Analyses of Crude Oils from Some of the More Recently Discovered Rocky Mountain Fields. W. Murphy and H. M. Thorne. *Bur. of Mines*, R.I 3358, Dec. 1937.—The properties and yields of major products from the Bureau of Mines (Hempel) distillation of a number of crude oils from recently discovered Rocky Mountain fields are given. The following crude oils are covered: *Wyoming*—Lance Creek (3), Medicine Bow, Quealy Dome, Rock Creek, Waugh Dome and Wertz field. *Montana*—Cut Bank, Pondera. *Colorado*—Hiawatha and Powder Wash. C. L. G.

513. Extraction of Salts by the Electrical Process. T. N. St. Hill and G. B. Hanson. *Refiner*, 1937, **16** (10), 466.—The de-salting of crude oil may be operated in three stages: (1) Fresh water and incoming crude are mixed under controlled conditions. (2) The mixture enters the electrical treater and is subjected to the action of a high-tension field between electrodes. The minute water particles coalesce and settle out, taking in solution 90–95% of the salts in the crude. (3) The salt water is continuously removed from the bottom of the treater and the oil is pumped from the top. In general, a single unit will treat about 1500 brls. per day. The treater is a pressure vessel 10 ft. diameter × 12 ft. high, built for pressures of 35 lb. per sq. ft. Two or more insulated electrodes are suspended therein. Step-up transformers are placed on top of the treaters and convert 230-volt A.C. current to 16,500 volts. A suitable electrode consists of a number of concentric rings of ribbon steel extending vertically. The process involves no extra cost for labour nor for heat. The over-all costs may be from 0·75 to 1·2 cents per brl. Estimates for saving the cost of shut-down time range from $1000 to $1800 per day. G. R. N.

514. Patents on Crude Oil. M. De Groote. U.S.P. 2,104,793–2,104,795, 11.1.38, U.S.P. 2,106,239, 25.1.38, U.S.P. 2,106,241–2,106,244, 25.1.38. M. De Groote and B. Keiser. U.S.P. 2,106,240, 25.1.38. Demulsifying agents for breaking petroleum emulsions of the water-in-oil type. W. S. E. C.

Gas.

515. Application of Liquefied Natural Gas to Oil Development and Production. A. E. Sweeney. *Oil Gas J.*, 16.12.37, **36** (31), 44.—The greatest potential outlet for liquefied petroleum gases is in specially designed internal-combustion engines. Considerably higher compression ratios can be used (similar to those in diesel engines) owing to the high octane ratings (*e.g.* propane and butane 125 and 99, respectively). The low vaporization temperature results in a larger quantity of available heat per explosion and gives greater power output, better distribution, and ease of starting, reduced dilution of lubricating oil, carbonization and exhaust smoke, etc. Liquid butane and propane show to greatest advantage when running at full load, especially from the point of view of fuel distribution. For the same compression ratio butane develops slightly greater power than gasoline, but is not quite as thermally efficient. At higher compression ratios at which gasoline could not be used, butane and propane operate at much higher thermal efficiencies. The heat of vaporization of liquid gases may be used to cool the engine water, preferably in a closed system, using very good water to avoid scale formation. Specially designed engines to take these fuels should not weigh more than 5 lb. per h.p. output.

A graph of thermal efficiency *versus* compression ratios of propane is reproduced, together with a table showing octane numbers of the lighter paraffin hydrocarbons. It is suggested that ethane and methane could be used for repressuring or pressure maintenance projects, smaller quantities of gas being required to give the same pressure as natural gas would give. Liquefied gases may also be used to provide fuel for the operation of the lease and for the production of electric power, etc. C. L. G.

516. Desulphurization of Gas. L. Sabrou. *Bull. Ass. franc. Tech. Petrol.*, 1937, (40), 59–74.—After having detailed the limits of sensitivity of lead acetate paper, the reagent universally employed for the detection of hydrogen sulphide in gas, the author reviews the different variations of the two chief methods of gas purification, *i.e.* by means of reactive solids, generally consisting of some variety of iron oxide; or by means of reactive liquids which are usually solutions of alkaline salts giving a reversible reaction. E. N. T.

517. Recovery of Sulphur Dioxide from Waste Gases. H. F. Johnstone, H. J. Read and H. C. Blankmeyer. *Industr. Engng Chem.*, 1938, **30** (1), 101.—Theoretical considerations indicate that the solutions having the maximum capacity for absorbing sulphur dioxide from dilute gases, *in* a cyclic system and which require the minimum quantity of steam for their regeneration, are those containing sulphites of bases with an ionization constant of 10^{-6} and solutions of salts of weak acids saturated with the free acid, for which $KaKs = 10^{-4.4}$. To assist in obtaining data on the recovery of sulphur dioxide from waste gases by a cyclic process, the authors have determined the partial vapour pressures at 35°, 50°, 70° and 90° C. and over a wide range of compositions of sulphite–bisulphite solutions of sodium and methylamine. From the results obtained interpolation formulæ are presented to represent the vapour pressures as a function of temperature and solution compositions. Sufficient data for a number of other sulphite–bisulphite solutions are reported to indicate the effect of the nature of the solution on the temperature coefficient of the vapour pressure of sulphur dioxide. H. E. T.

518. Patents on Gas. R. F. Bacon and R. Fanelli. E.P. 478,544, 20.1.38. Recovery of SO_2 from gases by absorbing the SO_2 in an aqueous salt solution containing a free weak acid, *e.g.* alkali or ammonium salt of the group consisting of acetic, benzoic, citric, fumaric, lactic, phosphoric, phthalic, salicylic or tartaric acids. The SO_2 is expelled by heating and the salt regenerated.

G. W. Johnson. E.P. 478,877, 21.1.38. Removal of organically combined sulphur from gases by treating the gas in the presence of oxygen under alkaline conditions with an active charcoal prepared from mineral coal.

G. W. Johnson. E.P. 478,973, 28.1.38. Apparatus for the removal of CO from gases containing H_2 by washing the gas with ammoniacal cuprous chloride solution and regenerating the used copper salt solution by expelling the CO in two stages of vacuum—the higher vacuum employed in the first stage. W. S. E. C.

Cracking.

519. Patents on Cracking. R. M. Parsons. U.S.P. 2,105,500, 18.1.38, U.S.P. 2,105,819–2,105,820, 18.1.38. Improved furnace for cracking plants.

A. J. van Peski. U.S.P. 2,105,850, 18.1.38. Reforming gasoline distillate by contacting it at 225–500° C. with phosphoric acid deposited on coke in the presence of a small quantity of a tertiary alkyl halide.

E. A. Ocon. U.S.P. 2,106,013, 18.1.38. Treatment of bituminous substances to produce anti-knock gasoline by subjecting the vapour to the action of a metal halide catalyst to remove polymerizable constituents as liquid polymers. The latter are hydrogenated without substantial cracking to yield saturated hydrocarbons of higher boiling range than gasoline and a portion of these hydrocarbons is added to the bituminous substances and subjected to conversion. W. S. E. C.

Hydrogenation.

520. South Wales Coal–Oil Plant. Anon. *Chem. Tr. J.*, 17.12.37, **101**, 541.—A low-temperature carbonization plant is being constructed on the edge of the South Wales coalfield at Bridgend by the South Wales Coalite Co., Ltd. The plant will use

500–780 tons of coal per day, and should yield 14 cwts. of Coalite and 20–25 gls. of oil and petrol per ton. The plant will consist of a carbonizing plant similar to that at Bolsover, a coal–oil distillation unit producing aviation spirit, diesel oil, fuel oil, etc., and a large plant for the manufacture of tar acids and other chemical products. When completed, the total quantity of coal treated by the Coalite process will be approximately 1,000,000 tons a year. C. L. G.

521. Coal Oils in Germany. Anon. *Chem. Tr. J.*, 31.12.37, **101**, 592.—In a statement by the International Hydrogenation Engineering and Chemical Co. at the Hague the total capacity of all hydrogenation processes in production or under construction in Germany is given as about 1,900,000 tons per annum, and that of the Fischer plants as about 700,000 tons. It is estimated that it will take several years before these ultimate capacities are reached, by which time hydrogenation plants will be supplying by far the greater part of the synthetic motor fuel production. The 1938 production of motor spirit is expected to reach 900,000 tons from hydrogenation and 250,000 tons from Fischer plants. C. L. G.

522. Patents on Hydrogenation. Anglo-Iranian Oil Co., and A. E. Dunstan. E.P. 470,081, 9.8.37. Hydrogenation of unsaturated compounds to produce the corresponding paraffins, *e.g.* di*iso*butylene to *iso*-octane, under a pressure of 500–3500 lb. per sq. in., using freshly reduced ferric oxide as catalyst.

F. Uhde. E.P. 477,030, 15.12.37. Vapour-phase hydrogenation of normally solid, liquid or gaseous hydrogen-containing substances at raised temperatures, and if desired, under increased pressures. The catalysts consist of solid electrically conducting substances, *e.g.* metals and/or carbon and/or electrolytes which are formed into grains and packed between two or more electrodes.

L. E. Jones. E.P. 477,944, 10.1.38. Production of motor spirit, and diesel fuel by the hydrogenation of fusible carbonaceous material containing $> 50\%$ by vol. of asphalt, using a tungsten disulphide catalyst.

G. W. Johnson. E.P. 478,003, 11.1.38. Production of olefines containing 2–4 carbon atoms in the molecule by dehydrogenation of the corresponding saturated hydrocarbon at elevated temperatures. The catalyst used is chromium oxide containing also a halide of an alkali or an alkaline-earth metal.

T. H. Durrans and B. T. D. Sully. E.P. 478,386, 18.1.38. Preparation of nickel catalyst in particular for the hydrogenation of crotonaldehyde to butyraldehyde or butyl alcohol.

T. H. Durrans and B. T. D. Sully. E.P. 478,487, 19.1.38. Reactivation of nickel catalyst used in process described in the previous patent.

H. E. Potts. E.P. 478,603, 21.1.38. Temperature-measuring devices used in reaction vessels for the hydrogenation of carbonaceous substances. W. S. E. C.

Polymerization.

523. Synthetic Resins from Coal-Tar Hydrocarbons. W. H. Carmody, W. Sheehan and H. Kelly. *Industr. Engng Chem.*, 1938, **30** (3), 245.—A new heat polymerization process has been developed for the production of synthetic resins from unsaturated aromatic hydrocarbons obtainable in quantity from coal tar. Di*cyclo*pentadiene, indene and coumarone are the raw materials for the process, and these hydrocarbons were previously considered to be by-products in the coal-tar industry of little value, and limited use. The polymers of di*cyclo*pentadiene, indene and coumarone are now produced in quantity at low cost, and are of great use in the floor-tile and varnish industries. Other specialized uses for these polymers have been developed in order to utilize their valuable properties. The polymers are chemically inert bodies, and are unaffected by practically all industrial brines, alkalis and acids. H. E. T.

524. Patents on Polymerization. Du Pont Viscoloid Co. E.P. 477,364, 28.12.37. Polymerization of organic liquids to produce solid shapes—by heating the initial material containing benzoyl peroxide as catalyst—in an elongated mould closed at one end.

B. Malishev. E.P. 478,424, 14.1.38. Treatment of hydrocarbons, *e.g.* polymerization or alkylation, using as catalyst, P_2O_5 which has been activated with H_2S, HCl, HBr, HI, HF or HCN.

G. W. Johnson. E.P. 478,601, 21.1.38. Polymerization of olefines containing up to 7 carbon atoms in the molecule at 180–300° C. to obtain liquid products. Aluminium fluoride is used as catalyst.

Universal Oil Products Co. and A. L. Mond. E.P. 478,996, 28.1.38. Catalytic treatment of motor fuel at 450–700° C. with granular catalysts, *e.g.* MgO and $< 10\%$ of added compounds such as lead chromate and zinc sulphate. W. S. E. C.

Refining and Refinery Plant.

525. Processing Talco Crude. J. C. Albright. *Refiner*, 1937, **16** (11), 60.—Talco crude from N.E. Texas is processed in a 5200-brl. refinery at Mount Pleasant. The crude after salt removal is topped in a modern pipe-still unit and the reduced crude is cracked in a Dubbs unit. Reforming of a suitable cut allows the production of a 70-octane gasoline refined by doctor treatment plus addition of U.O.P. inhibitor. The reduced crude can also be separated in a vacuum tower into a distillate gas oil and a residual asphalt, which, by suitable control of the tower operation and/or air blowing, fulfils the requirements for roofing flux, rapid and medium-curing cutbacks, waterproofing and shingle asphalt. G. R. N.

526. Investigation into the Cost of Oil Absorption Plant for Natural Gasoline Recovery at High Pressure and Low Temperature. A. H. Nissan. *J. Instn Petrol. Tech.*, 1938, **24**, 69–111.—A comprehensive study of the effect of varying operating temperatures and pressures on the cost of recovering gasoline from natural gas by an oil-absorption process. G. R. N.

527. Special Gasoline Columns. Anon. *Refiner*, 1937, **16** (9), 403.—At the Earlsboro gasoline plant of the Bainsdall Oil Co. a battery of four fractionating columns was installed to manufacture special products from the raw gasoline made in the absorption plant. The latter plus a constant proportion of compression gasoline is charged to the first or depropanizing column operating at 300 lb., and propane is removed overhead. The bottom product is delivered to the second or debutanizing column operating at 80 lb. and yields butane overhead and a butane-free natural gasoline, *e.g.* 26/70 grade. The third column is used for special gasoline manufacture from the stabilized natural gasoline, and close-boiling-range pentanes and hexanes can be obtained. If propane is required for the market, the overhead from the first column is charged to the fourth column in which it is stripped of ethane. A distinctive feature of the plant is the rigid instrument control of the operation. G. R. N.

528. Refining Cracked Gasoline from Oil Produced outside of U.S.A. J. C. Morrell, C. G. Dryer and G. Egloff. *Oil Gas J.*, 30.12.37, **36** (33), 101 and 6.1.38, **36** (38), 54.—The refining of cracked gasolines from crude-oil sources obtained from the most important oil-producing fields of 13 countries is dealt with. The present tendency in refining in the U.S.A. is toward the elimination of any treatment which is not necessary to the essential quality of the motor fuel. Thus acid treatments are largely eliminated where gum-forming tendencies may be overcome by the addition of inhibitors. Large quantities of gasoline are being marketed with sulphur content of 0·3% and higher without any deleterious effects on the motor.

The cracked gasolines obtained from a Dubbs pilot cracking unit using a variety of stocks ranging from naphthas to fuel oils were examined. The sources of the oils were: Russia, Venezuela, Rumania, Iran, Sumatra, Mexico, Iraq, Argentina, Canada, Bahrein Island, Dutch East Indies, Greece and Sakhalin Island. The methods of

treatment applied in each case were selected in accordance with type of gasoline produced.

The methods for refining selected include (1) simple acid and caustic treatment; (2) simple acid-plumbite treatment; (3) split plumbite treatment; (4) split caustic treatment; (5) vapour phase clay treatment. An outline of the method of application of each refining treatment is given. The methods adopted for re-running refined oil to desired end-point and the subsequent treatments applied to eliminate SO_2 formed during distillation and to sweeten the gasoline, if necessary, are also described. Solution and polymerization losses were estimated where necessary and the means employed are described. Tables are presented for each country of origin to show the types and properties of cracking stocks, treatments applied, solution and polymerization losses, distillation ranges, octane numbers, colours, colour stabilities, sulphur contents, oxygen bomb stabilities and copper dish gum contents of the treated products. In most instances the effects of addition of 0·025% of U.O.P. inhibitor No. 1 to the treated gasolines in respect of oxygen-bomb stabilities and copper dish gum contents are also indicated. R. A. E.

529. Chemical Refining of Lubricating Oils. R. Navarre. *Bull. Ass. franc. Tech. Petrol.*, 1937, (40), 37–57.—This is the second of two articles in which are described the plants used for the phenol treatment and solvent recovery processes in the refinery of Port-Jérôme, with a discussion of the theoretical principles involved. The author also deals with some recent developments in the utilization of the temperature gradient, the operation of the recycling process and the chemical fractionation of the products. E. N. T.

530. Skelly Special Products Plant. J. C. Albright. *Refiner*, 1937, **16** (9), 436.—In line with the increased use of propane and butane the Lyman natural gasoline plant of the Skelly Oil Co. has been improved by installing three new columns to produce these gases to specification. The third column is of particular interest, being employed to dehydrate and de-ethanize the propane. It is 3 ft. in diameter, 55 ft. high, and is designed for a working pressure of 750 lb., but conditions of dehydration do not require pressures much above 400 lb. Temperatures applied to the propane in the re-boiler of this column are controlled at the inlet of the steam to the shell. Reflux on the column is obtained by direct condensation from sections installed on the top of the tower maintaining a temperature sufficiently low to ensure that all propane is driven back down the column to the base outlet. Instrument control is very comprehensive. G. R. N.

531. Pipe Still and Cracking Unit versus Combination Unit. N. F. Chamberlain. *Refiner*, 1937, **16** (12), 571.—The calculations are based on the processing of 8000 brl. per day Mid-Continent crude which yielded 46·83% high octane gasoline, 15·66% U.S. Motor Gasoline (wholly straight run), 5·64% kerosine, 27·10% fuel oil, 4·77% loss. It is assumed that the yields and the products are the same for both systems. The total investment for the cost of the system complete is $273,100 less for the combination unit and also $172 less for the daily operating costs. The cost of maintenance for the combination unit was the only cost item that proved to be higher for this unit. The cracked gas produced was insufficient as fuel for the separate units, but more than sufficient for the combination unit. Comparing the profits with the investment cost the pay-out period was 2·39 years for the combination unit and 3·50 years for the separate units. Although the calculations are based on average figures, the difference is so great that it is believed the combination unit will practically always be found to be the more economical. G. R. N.

532. Flanged Joints for Piping. C. L. Seigel. *Refiner*, 1937, **16** (9), 422.—It is concluded, from a study of available information, that flanged joints in the 150 and 300 lb. standard classifications, with the generally used raised facings, show a wide range of variation when investigated from a design standpoint. Some sizes are more subject to leakage than others when placed in service. Consequently it is necessary that more careful attention be given to the erection of certain sizes of piping systems than may be required by other sizes. On some sizes unusual care must be taken to prevent leaks, and on others overstressing of the bolts is likely to occur. By cautious

erection the standard joints may be successfully used, but should it seem desirable that better-proportioned flanged joints be used for a particular installation, it is necessary to utilize special facings on the flanges. G. R. N.

533. Metallurgy of Petroleum Refining Equipment. E. S. Dixon. *Refiner*, 1937, **16** (10), 448.—An extensive illustrated discussion of the metallurgical aspects of refinery equipment with special reference to the practice of The Texas Company. The paper deals with liners, tubing, metal temperatures, protective coatings for the prevention of corrosion, study of corrosion and testing procedures, exchanger tubes and treating units. G. R. N.

534. Care of Centrifugal Pumps. Anon. *Refiner*, 1937, **16** (12), 589.—A short discussion on the maintenance of centrifugal pumps with reference to checking clearances, horizontal wear of bearings, checking couplings, balance, cleaning the passages, inspection routine, pulsation reactions, vibration detection, casing fractures and packing practices. G. R. N.

535. Condenser Tube Corrosion—Some Trends of Recent Research. R. May. *Trans. Inst. Marine Engrs*, 1937, **49** (8), 171–176.—The study of condenser-tube corrosion was commenced in 1910 by the Institute of Metals and a number of papers have appeared at intervals.

In the days of the reciprocating engine, dezincification was the main cause of tube failure. With the introduction of the steam turbine, however, "impingement corrosion" or "corrosion erosion," caused by high water speeds, became the chief cause of trouble. This has been controlled to some extent by making the tubes of a more resistant alloy.

The problem of the pitting of tubes has now come to the fore. In the early days this was probably masked by dezincification or impingement attack.

This type of corrosion is undoubtedly an electrochemical process.

It is often hindered and in some cases almost entirely prevented by the formation of a protective film on the metal.

Types of corrosive action in condensers may be classified as :—

1. Slow general corrosion or layer dezincification under a protective scale.
2. Pitting due to extremely localized failure of the protective film.
3. Deposit attack characterized by more or less extensive areas of attack taking place under deposits of foreign matter.
4. Impingement attack.
5. True "erosion" of scale by abrasives in the water.
6. General irregular attack due to disintegration of protective scale by chemical action.
7. General thinning due to presence of acids, etc.

The various causes of tube corrosion are stated. The most important—because their direct control is impractical—are : (*a*) the corrosive properties of the water, (*b*) the occurrence of bubble impingement, (*c*) the formation on new tubes of an unstable type of film.

The corrosive properties of water are usually due to the presence of small quantities of active substances like H_2S, various organic sulphur compounds produced by bacteria or by marine plants, manganese compounds or certain types of bacteria.

The control of corrosion is discussed and suggestions are made for reducing it as far as possible. The composition of corrosion-resisting alloys for condenser tubes is also considered. D. L. S.

536. Refractory Selection for Cracking Furnaces Calls for Compromise. M. G. Van Voorhis. *Nat. Petrol. News*, 26.1.38, **30** (4), R. 19.—In recent years important developments have been made in the manufacture of refractories and some new types are available. The introduction of the power-press operating at pressures up to 10,000 lb. has achieved greater uniformity of size, texture, and homogeneity and improvements in strength. Five types are in general use. These are high-heat-duty fireclay brick, normal and special super-duty fireclay brick, and 50% and 60% high-softening-temperature alumina brick. All consist chiefly of the oxides of alumina

and silicon. Other types which find a limited application in special connections are silica brick, magnesite and chrome brick. The choice of brick for a particular purpose must always be made in relation to service conditions. A table classifies the above five types according to their (1) Al_2O_3 content, (2) softening temperature, (3) porosity, (4) modulus of rupture cold, (5) crushing strength cold, (6) resistance to spalling, (7) subsidence under load at high temperature, (8) slag resistance (acid sludge and oil ash), (9) constancy of volume at high temperature, (10) heat-storage capacity, (11) thermal expansion and (12) price. In general (2), (3), (4), (6), (8) and (12) increase with increase of Al_2O_3 content. Although refractories have low heat capacities, their insulating properties are sometimes relatively low, and it is common practice now to back refractories with insulators such as diatomaceous earth, expanded mica, etc. Bricks that combine both properties are available, but they show poor resistance to slag formation. H. G.

537. Patent on Refinery Plant. H. R. Swanson. U.S.P. 2,105,935, 18.1.38. Apparatus for two-stage distillation of hydrocarbon oils. W. S. E. C.

See also Abstract No. 576.

Chemistry and Physics of Petroleum.

538. Hydrocarbons in Virgin Naphthas. C. O. Tongberg, M. R. Fenske, and W. J. Sweeney. *Industr. Engng Chem.*, 1938, **30** (2), 166.—During the past three years the Petroleum Refining Laboratory of the Pennsylvania State College has fractionated by a standardized method approximately twenty virgin naphthas from different fields in various parts of the world. As a result of this work a great deal of information has been accumulated regarding the chemical composition of naphthas.

Normal paraffins, *iso*paraffins, naphthenes of both the *cyclo*pentane and *cyclo*hexane series, and aromatics were identified, and in some naphthas all these species were found. For convenience of classification the naphthas were grouped either as paraffinic or naphthenic types, designating as paraffinic those naphthas containing normal paraffins, and as naphthenic those containing normal paraffins only in very small amounts. The paraffinic type is conveniently grouped into

1. Naphthas containing large amounts of normal paraffins.
2. Naphthas containing considerable amounts of normal paraffins and also large amounts of aromatic hydrocarbons.
3. Naphthas containing appreciable amounts of normal paraffins and moderate amounts of naphthenic hydrocarbons.

The naphthenic type of naphtha may conveniently be grouped into

1. Naphthas containing large amounts of naphthenes of the *cyclo*hexane type but only traces of normal paraffins.
2. Naphthas containing large amounts of naphthenes of the *cyclo*pentane type, but only traces of normal paraffins.

The following hydrocarbons were present in practically all of the twenty virgin naphthas: *iso*Pentane, *n*-pentane, *cyclo*pentane, *cyclo*hexane, methyl*cyclo*hexane, dimethyl*cyclo*hexanes, ethyl*cyclo*hexane, a naphthene boiling at 135–136° C., a naphthene at 143–146° C., and a naphthene at 151–153° C. The predominating hydrocarbon in all these naphthas was methyl*cyclo*hexane. Also contrary to expectations aromatic hydrocarbons are present only in low concentrations in naphthenic naphthas. In addition to benzene the following aromatic hydrocarbons have been identified in many naphthas: toluene, ethylbenzene, xylene and hydrocarbons boiling at 153°, 157°, 163°, 168° and 171° C.

By careful selection of the virgin naphtha as starting stock for a standard fractionation, it appears possible to prepare specific fractions constituting 5% or more of the over-all virgin naphtha, such fractions containing 50% or more of a definite hydrocarbon. These definite hydrocarbons, as far as the naphthas so far studied are concerned, are, 2-methylbutane, *n*-pentane, 2-methylpentane, *cyclo*pentane, *n*-hexane, methyl*cyclo*pentane, *cyclo*hexane, *n*-heptane, methyl*cyclo*hexane, toluene, dimethyl-

*cyclo*hexanes, *n*-octane, ethylbenzene, xylenes, *n*-nonane, 9-carbon atom aromatics and *n*-decane.

A great chemical industry has been developed for hydrocarbons from coal tar. It should be possible to develop similar fields for normal paraffins, *iso*paraffins, *cyclo*pentane hydrocarbons, and *cyclo*hexane hydrocarbons from the almost unlimited petroleum reserves. H. E. T.

539. Viscosities of Hydrocarbons. Parts I–III. E. B. Evans. *J. Instn Petrol. Tech.*, 1938, **24**, 38–53.—A critical review of viscosity data, together with some considerations on the measurement of viscosity, the use of small viscometers and the viscosities of the normal paraffins. G. R. N.

540. Thermodynamic Properties of Hydrocarbons. W. C. Edmister. *Industr. Engng Chem.*, 1938, **30** (3), 352.—The effect of pressure on specific heats at constant pressure, entropy and enthalpy are computed in reduced or generalized units for hydrocarbons. These calculations are based on a new correlation of P-V-T data. The effect of temperature on these thermodynamic properties can be computed by means of a new equation for specific heat at one atmosphere, which is based as a correlation of the data of previous investigators. By means of a table of generalized thermodynamic properties and the equations presented in this paper, it is possible to compute all the thermal properties for any hydrocarbon for which critical data are available. H. E. T.

541. Slow Combustion of Gaseous Paraffins Especially Propane. R. N. Pease. *Chem. Rev.*, 1937, **21** (2), 279.—The experiments described in this paper were undertaken to investigate the relation of the rate of oxidation of propane to the propane and oxygen concentrations—that is, to obtain further information about the kinetics of propane oxidation subsequent to the induction period. The experiments were conducted in a Pyrex bulb 2·5 cm. in diameter and 18 cm. long, heated electrically, the temperature being controlled manually to within 1° C., and read on a mercury thermometer graduated in half degrees. The propane and oxygen were measured into a mixing bulb and thence passed to the reaction tube; small quantities of acetaldehyde were vaporized into the reaction bulb before the introduction of the propane and oxygen. The reaction bulb was adequately exhausted after each experiment by means of a Langmuir pump connected to a liquid air trap and Hyvac pump. The exit tube from the reaction bulb was heated by a resistance winding to prevent condensation. Further experiments were carried out with the surface of the bulb coated with potassium chloride. From the results obtained on the slow oxidation of propane at 270–280° C. it is evident that treating the reaction bulb with potassium chloride greatly lengthens the induction period, thus indicating that the primary reaction occurs on the surface, in accordance with the author's views. Additions of small amounts of acetaldehyde shortens but does not eliminate the induction period, a fact that confirms previous conclusions that peracids (formed from aldehyde) are unimportant in the reaction scheme. Experiments after the potassium chloride treatment indicate that conditions favouring access to the walls of the reaction bulb diminish the rate of reaction to a great extent. These facts, together with the previously observed destructive action of the treated wall on peroxides, show that the latter play an important rôle in the slow oxidation of the higher paraffins, whatever may be the case for methane and ethane. H. E. T.

542. Observations on the Oxidation of Propane. E. J. Harris and A. Egerton. *Chem. Rev.*, 1937, **21** (2), 287.—Experiments have been carried out in the slow oxidation of propane both by the "flow" and "static" methods; and the results obtained add a few further facts to our knowledge of the oxidation of this hydrocarbon.

In the flow system a measured volume of gas (600 c.c.) was drawn at a constant rate through a reaction vessel 10 cm. long and 1·1 cm. in diameter, maintained at a constant temperature. A tube projected into a trap cooled to − 40° C. at the exit end of the reaction vessel. The gas then passed to a water scrubber and thence into an aspirator; a second tube containing 2 : 4-dinitrophenylhydrazine sulphate could be used to ascertain whether the absorption of aldehyde was complete. The volume of gas and weight of condensate were ascertained.

In the static method a silica reaction vessel 42 cm. long and 1·4 cm. in diameter was connected at one end to a gas burette and at the other end to a manometer and T-tube. The reaction vessel could be connected either to a Hyvac pump or to a trap for condensation of the liquid products, the gas being sucked into a second gas burette by a Toepler pump arrangement. In order to obtain sufficient condensate six separate charges of gas were allowed to react to as nearly as possible the same extent as indicated by the pressure gauge. Any aldehyde escaping the trap was collected in a small volume of water.

Analyses were made for peroxide by the iodine method, using ammonium molybdate as catalyst, for total aldehydes by titrating the alkaline solution before and after oxidation with hydrogen peroxide solution, and for formaldehyde by the mercuric chloride method after distillation to remove alcohols. Ethyl and methyl alcohols were determined in the distillate by oxidation with dichromate.

The gas analyses were carried out in a Bone and Newitt apparatus with the addition of a tube of palladinized asbestos for the hydrogen determination. In the static experiments the silica vessel was treated with sodium or potassium chloride and the reaction was allowed to proceed to completion. The results obtained indicate that

(i) Peroxides are only found when the surface does not destroy them too fast to prevent their detection. In the vapour state hydrogen peroxide appears to be mainly present and dihydroxymethyl peroxide in the condensate.

(ii) Propylene is formed early in the reaction, possibly from the aldehydes which instigate the reaction.

(iii) Methyl alcohol and aldehydes appear to be formed by the same chain process.

H. E. T.

543. Rate of Ethylene Polymerization. F. R. Russel and H. C. Hottel. *Industr. Engng Chem.*, 1938, **30**, 183.—The present investigation was carried out in order to determine how cracking and uncatalysed polymerization differ as to reaction order and effect of temperature on reaction rate, when the reaction is carried out in a single phase, either gaseous or liquid. Ethylene was chosen as the most suitable material for study. The apparatus employed was designed by the writers to permit the filling of a pressure chamber with a known quantity of ethylene, the introduction of naphthalene under pressure to dissolve the ethylene completely, the accurate metering of the naphthalene to guarantee the presence of but one phase in the reaction chamber, the rapid heating and cooling of the reaction chamber before and after its maintenance at the high temperature of polymerization for a measured time, and the determination of the quantity of unpolymerized ethylene. The results obtained show that :—

1. The rate of polymerization of ethylene in the gas phase differs but little from the rate of polymerization when dissolved in liquid naphthalene to the same concentration, in spite of the presence in the latter case of fourteen molecules of naphthalene to one molecule of ethylene.

2. In the gas phase, the polymerization in its early stages is a second-order reaction; whilst in the liquid phase the polymerization is of an order between the second and third in the early stages of the reaction.

3. As polymerization proceeds the rate of reaction does not decrease. It is therefore concluded that secondary reactions occur between ethylene and its polymers. No reaction between the naphthalene and ethylene was detected.

4. Increasing the surface area of the reaction bomb was without appreciable effect on the reaction, indicating the polymerization reaction to be homogeneous.

5. The effect of temperature on the primary reaction was to double the rate of reaction for every 26° F. increase in temperature over the range 640–780° F.

6. The corrected energy of activation was 40,000 calories per gram-mole for the liquid-phase reaction, and 42,100 for the gas-phase reaction. H. E. T.

544. Polymerization of Propylene by Dilute Phosphoric Acid. L. A. Monroe and E. R. Gilliland. *Industr. Engng Chem.*, 1938, **30** (1), 58.—The catalytic polymerization of propylene has been carried out using dilute phosphoric acid as catalyst at temperatures above 250° C. and at pressures of 150 atmospheres or higher. The propylene was prepared by dehydration of commercial constant-boiling *iso*propyl alcohol over alumina at 450° C.; the gas thus obtained analysed 98% unsaturated. The reaction

vessel consisted of a cylindrical copper-lined steel vessel of 625 mls. capacity, heated by an electric heating coil wound externally, the temperature being controlled to within $\pm 5°$ C. of the desired value. During the course of the reaction the reactor was agitated by an external rocking device at approximately 40 cycles per minute. From the results obtained from a large number of runs, it is concluded that the reaction is stepwise. The first product is dimer; this in turn reacting with more propylene to form trimer, and the latter compound then combining with more propylene to form tetramer. At temperatures of 300° C. and above, and also at phosphoric acid concentrations of between 30 and 40% and higher, the character of the total polymer undergoes a marked change; an excess of heavier polymers being formed at the expense of the yield of dimer. Below 300° C. and at acid concentrations below 30%, the composition of the products depends solely on the extent of polymerization of the feed, and varies from practically pure dimer initially to about 35% dimer at the completion of the reaction. Within these limits the rate of dimer formation from propylene is approximately proportional to the square of the reactant concentration in the gas phase above the phosphoric acid catalyst, as well as to the volume and concentration of the latter. The theory of the mechanism proposed by the authors is hardly in accord with that proposed by V. N. Ipatieff (*Industr. Engng Chem.*, 1935, **27**, 1067) to account for his results on the polymerization of propylene by 100% phosphoric acid.

H. E. T.

545. Mechanism of Polymerization of Pure Olefines. F. Jostes and W. Bartels. *Oel u. Kohle*, 1937, **13**, 1166.—An attempt was made to establish the course of polymerization by examination of intermediate products. For this purpose olefines with < 7 carbon atoms were chosen because their moderate tendency to polymerization should facilitate control of the reactions. For the same reason a mild catalyst had to be found; P_2O_5 was finally selected.

Heptene gave a low-boiling, unsaturated intermediate product, the properties of which suggested a dimeric structure, the two molecules having joined to give a branched-chain, and not a straight-chain polymer. Small proportions of tri- and tetra-mers were obtained. Attempts to establish the position of unsaturated linkages in the polymers by ozonolysis failed because ozone was found to react with both the saturated and unsaturated C links.

Higher olefines (octene and dodecene) gave no more than dimers even under relatively severe conditions.

In the case of propene, no intermediate products were identifiable. The final polymer contained lubricating oil as well as gas oil (the only product of heptene polymerization). The gas-oil constituent was further polymerized with $AlCl_3$, yielding an oil of poor viscosity curve, from which it is deduced that the oil consisted mainly of branched-chain hydrocarbons.

P. G. H.

546. Polymerization of Unsaturated Hydrocarbons. H. I. Waterman and J. J. Leendertse. *J. Instn Petrol. Tech.*, 1938, **24**, 16–37.—A paper to the Second World Petroleum Congress, Paris, giving an account of the Delft researches on the nature of the polymerization products of the various types of unsaturates.

G. R. N.

547. Olefins and Conjugated Dienes from Gas Oil. H. Tropsch, C. L. Thomas, G. Egloff and J. C. Morrell. *Industr. Engng Chem.*, 1938, **30**, 169.—Four useful conclusions are reached regarding diene formation; they are:—

1. Since aromatic hydrocarbons are produced from almost any hydrocarbon source, conjugated dienes should be also. On this basis a gas oil should be a convenient source.

2. Aromatics are produced at temperatures usually above 600° C. in vapour-phase cracking; similar temperatures should be employed in diene formation.

3. Since conjugated dienes are extremely reactive at temperatures above 600° C., the reaction time should be as short as possible.

4. The reaction to produce aromatics from most conjugated dienes is at least bimolecular; low pressures would hinder such bimolecular reactions.

In the actual experiments carried out the temperature was 800–1000° C., the pressure 50–500 mm., and the charging stock was Pennsylvania gas oil of density 0·8275 and average molecular weight 245.

The apparatus designed by the writers was arranged so that the gas oil from a charging burette could be passed through a capillary feed control to a flash pot maintained at 400° C., where the gas oil was vaporized. The vapours from the flash pot passed into a 1-cm. internal-diameter silica reaction tube packed with 6–10-mesh porcelain chips. The reaction tube was heated in a 30-cm. high-temperature furnace (silicon carbide resistance rods, heated electrically). Of the 30-cm. furnace, only about 15 cm. was heated to within $\pm$ 20° C. of the desired reaction temperature, and only this 15 cm. was used in calculating reaction times. The condensing and collecting system consisted of water-cooled, solid carbon dioxide or liquid nitrogen cooled traps. The vacuum pump permitted collection of the gaseous products and was filled with glycerol.

From the experimental results obtained it is concluded that Pennsylvanian Gas Oil can be made to yield products corresponding to 73% by weight of the charge (83% by weight of the reacted gas oil) by pyrolysis at 950° C. and 175 mm. pressure, with a contact time of 0·05 second. From a chemical synthesis point of view, the per cent. by weight of the various products are: ethylene, 28·2%; propene, 19·7%; butadiene, 6·6%; butenes, 8·3%; pentadiene, 3·1%; higher conjugated dienes, 7·2%; based on the gas oil which had reacted. Further, 10·8% of high-antiknock gasoline is produced.

Under the conditions studied, butadiene formation is not appreciably influenced by temperature (800–1000° C.) or pressure (50–500 mm.) provided the oil is gasified to the extent of 50 to 75% of the charge. H. E. T.

548. Water Tolerances of Mixtures of Gasoline with Ethyl Alcohol. O. C. Bridgeman and E. W. Aldrich. *Bur. Stand. J. Res., Wash.*, 1938, **20**, 1–8.—In a previous paper data were presented on the solubility of water in mixtures of ethyl alcohol with 23 different gasolines. An analysis of these results indicated that it was possible to correlate them by means of a general empirical equation.

This equation contains a constant K characteristic of the particular gasoline under consideration, and a table in the paper gives the values of this constant for the 23 gasolines examined. The accuracy of this equation was checked by comparing computed and observed values of the critical solution data. It was found that the difference between the observed and computed critical solution temperatures was 1·4° C., and that between the observed and computed water tolerances was about 0·005% of the total mixture. The characteristic constant K can be evaluated from a few solubility experiments with any particular gasoline, and thus the equation can be used to compute water tolerances at other temperatures or with other mixtures. D. L. S.

549. Critical Solution Temperatures of Mixtures of Gasoline, *n*-Propyl Alcohol, and Water. E. W. Aldrich. *Bur. Stand. J. Res., Wash.*, 1938, **20**, 9–16.—It has been shown that mixtures of ethyl alcohol and gasoline show only a small water tolerance, whilst the solubility of methyl alcohol in gasoline is less than that of ethyl alcohol solutions containing the same amount of water. It seemed probable that the solubility of the aqueous aliphatic alcohols in gasoline might increase with molecular weight.

Critical solution temperatures of mixtures of each of 3 gasolines with ethyl alcohol were first determined as a basis for comparison. Then with each gasoline, mixtures containing 5, 10, 15, 20 and 25% of *n*-propyl alcohol of various water contents were prepared and the separation temperatures were obtained.

It was found that at all temperatures of practical interest, the water tolerances of mixtures with *n*-propyl alcohol were greater than those made with the same percentage of ethyl alcohol. D. L. S.

550. Phase Equilibria in Hydrocarbon Systems. XIX. Thermodynamic Properties of *n*-Butane. B. H. Sage, D. C. Webster and W. N. Lacey. *Industr. Engng Chem.*, 1937, **29** (10), 1188.—The specific volumes of *n*-butane were measured over the temperature range 70–250° F., and pressure up to 3000 lb. per sq. in. The latent heat was also determined, and these data combined with other data previously reported were used to calculate the changes in entropy, enthalpy and fugacity. Results are presented in tables and graphs. The necessary thermodynamic relations are fully considered. P. D.

551. Boiling Points and Critical Properties of Hydrocarbon Mixtures. R. L. Smith and K. M. Watson. *Industr. Engng Chem.*, 1937, **29** (12), 1408.—The mean b.p. of a petroleum mixture may be defined in a variety of ways. The authors use various definitions in correlating physical properties of mixtures. These are :

(1) The cubic average b.p. used for correlating U.O.P. characterization factors and viscosities.

(2) True molal average b.p. for correlating pseudocritical temperature.

(3) The mean average b.p. (defined as the arithmetic mean between molal and cubic average b.p.) for correlating molecular weight, hydrogen content, heat of combustion and pseudocritical pressure.

(4) Weight average b.p. for correlating true critical temperatures.

These various b.p.s can be obtained from a graph showing the correction to be added to the volume average b.p. as determined by Engler. Graphs are given which show the correlation of the various properties mentioned above. P. D.

552. Calculation of the Number of Theoretical Plates for a Rectifying Column. B. F. Dodge and J. R. Huffman. *Industr. Engng Chem.*, 1937, **29** (12), 1434.—The method for calculating the number of plates for a binary mixture originally proposed by Lewis (*Industr. Engng Chem.*, 1922, **14**, 492) has advantages over the more frequently used McCabe and Thiele method when the number of plates required is large. The equations are derived in this paper on the assumption that the law of ideal solutions can be applied to the mixture, and illustrated by application to the separation of the oxygen isotopes by the distillation of water, and *n*-heptane-methyl*cyclo*hexane. P. D.

553. Performance of Bubble-Plate Columns. M. Souders, R. L. Huntington, H. G. Corneil and F. L. Emert. *Industr. Engng Chem.*, 1938, **30**, 1, 86.—Experiments were carried out in a column 12·5 in. diameter, using air-kerosine and air-lubricating oil systems at temperatures up to 200° F. Air and liquid rates, pressure drops and froth heights were observed. There were two bubble caps (4 in. o.d.) and one downspout, 2 in. i.d. The number of slots per cap was 32, the total slot area in both caps being 12 sq. in. The slots were 1 in. high. Liquid rates up to 13 gallons per minute (for the most part 5 g.p.m. and 8 g.p.m.) were used, and air mass velocities up to 1000 lb. per hour per sq. ft. The froth height was observed, and the mean froth density calculated from the pressure drop.

The pressure drop when the plate was dry was shown to be equal to that calculated by the orifice formula with constant 0·533.

At low heads (rate 5 g.p.m. with water or kerosine) the pressure drop is calculable on the assumption that the downspout can be treated as a weir. At intermediate heads (rate 9 g.p.m. for kerosine, 5 g.p.m. for lubricating oil) the formula for a free running orifice (constant = 0·5) applies. At highest rates the behaviour is that of an orifice with capacity diminished due to disengagement of vapour in the orifice, at a critical velocity the orifice becoming chocked with vapour. P. D.

554. Versatile Nomograph for Chemical Engineering Calculations. E. L. McMillen. *Industr. Engng Chem.*, 1938, **30**, 1, 71.—Many engineering calculations (*e.g.* the solution of heat transfer equations) involve the multiplication or division of numbers raised to various powers. A nomogram is presented which permits such calculations to be made rapidly. The numbers range from 10^{-3} to 10^{4}, and the powers from 0·05 to 20·0. Two forms of the chart are presented. P. D.

555. Manner of Liquid Flow through a Pipe-Line Orifice. O. L. Kowalke. *Industr. Engng Chem.*, 1938, **30**, 2, 217.—A series of photographs were taken of the flow of water and glycerin solutions through sharp-edged orifices in a glass tube. The range of Reynolds number used was 122 to 13,100. The flow was made visible by suspending aluminium powder in the water or solution, and illuminating at right angles to the direction of flow.

The photographs show clearly the entrainment in the jet on the down-stream side of liquid from the stagnant region. There is no sign that the jet undergoes further reduction in area after passing the orifice, as is commonly supposed. By

entraining bubbles of air in the liquid flowing to the orifice, and observing their behaviour on the edge of the hole, it appears that the liquid adjacent to the orifice edge is moving only very slowly, and the jet in effect does not occupy the whole area of the orifice. This is clearly brought out in the photographs of the jets. A mechanism which will account for this is suggested. P. D.

Analysis and Testing.

556. Study of Oils and Similar Materials at Low Temperatures. B. Steiger. *Ole, Fette, Wachse*, 1938, (1), 7.—Ethyl ether, contained in an enclosed Dewar flask, is evaporated by drawing air through it by means of a water pump. The temperature may be reduced to, and maintained at $-20°$ C. for long periods, or to $-25°$ C. if the Dewar flask is silvered. Two test-tubes pass through the cover of the flask and dip into the cooled ether. The one tube contains the sample under test; the other contains a sintered glass filter disc and is connected by a glass tube to the suction pump.

The apparatus, a diagram of which is given, is recommended for filtering paraffinaceous solutions. Several other special applications are suggested, *e.g.* the concentration and detection of pour-point depressants (such as Paraflow) in lubricating oil.

If the sintered glass filter be replaced by gauze, the filterability of diesel fuels at low temperatures can be studied. P. G. H.

557. Iodine Value of Benzines. B. Garre and H. Grosse-Oetringhaus. *Oel u. Kohle*, 1938, **14**, 94.—Complications due to substitution reactions are avoided by using Kaufmann's method, as already used in analysis of fats. The sample is allowed to react for 2 hours with a $N/5$-solution of bromine in methyl alcohol saturated with sodium bromide. Excess halogen is then titrated. Benzines of high I value may be weighed out in small ampoules, but samples of I value < 10 may be delivered from a small pipette with sufficient accuracy, the density being known. P. G. H.

558. Rapid Method of Determining Lead Tetraethyl in Benzine. W. Ulrich. *Oel u. Kohle*, 1938, **14**, 131.—100 c.c. of filtered sample are shaken for ½ minute with 10 c.c. 10% (vol.) bromine in carbon tetrachloride. A further shaking with 5 c.c. 65% nitric acid dissolves the $PbBr_2$ precipitate. After settling, the acid layer is run into a weighed porcelain crucible. The benzine is washed twice with 5 c.c. 10% nitric acid and the washings are added to the crucible. After the addition of 1 c.c. 10% H_2SO_4 the contents of the crucible are evaporated to dryness on a steam-bath, and finally heated gently until acid fumes are no longer expelled. Organic material is burned off by stronger heating. The residue is moistened with dilute nitric acid, evaporated, and treated with 2 drops concentrated H_2SO_4. Further heating to remove acid leaves $PbSO_4$ which is weighed as such.

For a 100-c.c. sample

$$PbSO_4 \times 0{\cdot}6427 = \%\ \text{(vol.) lead tetra-ethyl.}$$

Alcohol blends must be washed several times with distilled water before the above method is applied. P. G. H.

559. Determination of "True Colour" on the Tag–Robinson Colorimeter. H. Vinock. *Refiner*, 1937, **16** (12), 601.—"True Colour" had been determined previously on the Duboscq instrument, but the author has found it possible to use the Tag–Robinson instrument instead. The following procedure was devised. Plot on log-log paper the values for $M = aA/100 + bB/100$ (1), where M is the colour of the mixture, a and b are per cent. concentrations of the constituents of the mixture and A and B the colours of the constituents. If one constituent is a colourless diluent, then $M = aA/100$ (2). A curve of NPA colour versus No. 2 glass T-R colour is set up. The nearest NPA colour is determined and converted by the chart to true colour. From equation (2) the amount of colourless diluent to obtain T-R colour of 9¾–10¼ is calculated. The T-R colour is determined. This reading is converted to NPA colour and then to true colour if the value is outside the required range. If within the range

it is converted to true colour by equation (2). Solutions may be made up by trial and error to fall within the range 9¾–10¼ and calculation made directly. Benzene is used as the diluent. G. R. N.

560. Determination of Sulphur. H. Vinock. *Refiner*, 1937, **16** (9), 412.—Several methods for the determination of sulphur in petroleum oils are described and discussed. The lamp method is considered ideal for light oils, and fairly good for gas oils and light fuel oils—it is unsuitable for heavy and asphaltic oils. The main advantage of the Mabery combustion tube method, used for oils heavier than gasoline, is speed. Its disadvantages are uncertainty of control, need of skilled operators and "intellectual dishonesty." The A.S.T.M. oxygen-bomb gravimetric method is the most accurate and simple to operate. Its chief disadvantage is length of time for the determination. The oxygen-bomb turbidimetric method has the advantages of speed and accuracy, and the main disadvantage of personal "visual" error. The double-valve bomb method is volumetric, and is used for heavy oils, being preferable to the Mabery method. G. R. N.

561. Suggested Standard Method for Determination of Ash Content. Anon. *Tekn. Tidskr.*, 12.2.38 (Kemi No. 2), 16.—Describes method of test suggested as Swedish Standard. The test covers both oils and greases (ash as oxide). The accuracy obtainable is given as ± 0·001 for oils, ± 0·1 for cup greases and ± 0·5 for fibre greases and similar materials. R. F. S.

562. Effect of Paraffin Hydrocarbons on the Determination of Carbon Monoxide. K. A. Kobe and N. R. Dunbar. *Oil Gas J.*, 3.3.38, **36** (42), 59.—With the iodine pentoxide method of determining CO, when present in gas to the extent of 0·17 or less, it is necessary to remove other gases which will react with I_2O_5 by a purification train. However, the paraffin hydrocarbons cannot be removed by any method which does not involve the removal of CO. The effect of different paraffin hydrocarbons on this determination has accordingly been studied. It was found that up to 0·1% of H_2 did not affect the results, but if over 0·5% it should be determined separately. No reaction took place with CH_4, but with 1% of C_2H_6 reaction took place, the extent of which was about the same as the accuracy of the determination. With over 1% of propane, reaction took place to a larger extent than with ethane, but in general it may be disregarded unless present in large quantities. Hydrocarbons above propane react with I_2O_5, and should be removed by passing the gas through, for example, a liquid-air trap. C. L. G.

563. Nature of Petroleum Residues. H. Kamptner and E. Lutzenberger. *Oel u. Kohle*, 1938, **14**, 69.—This work relates to the separation of bituminous residues into several components by the use of physical methods. Full practical details are given for the quantitative determination of total asphalt (hard and soft), oil and petroleum resin.

1. The *total asphalt* is that portion which is insoluble in dioxan; by boiling with ethyl ether and filtration, this is further divided into hard asphalt (insoluble at 20° C.) and soft asphalt.

2. Evaporation of the dioxan filtrate yields "resin oil" which may be resolved into oil and resin by treatment with selective solvents (30–50° C. petroleum spirit–nitrobenzene, 1 : 8 by volume) at − 15° C. The nitrobenzene extract yields *resin*, the petroleum spirit raffinate containing *oil*.

The physical character of the original sample is stated to be much influenced by the quantity and composition of the total asphalt and by its mode of dispersion in the oil. The oil conforms with the Poiseuille law for true liquids.

The hard asphalt is considered to control the toughness, and the resins determine the adhesivity of the bitumen. P. G. H.

564. Materials Control in the Laboratory. G. F. Fitzgerald. *Refiner*, 1937, **16** (11), 563.—The smooth working of a petroleum testing laboratory is discussed with particular regard to the control of the stock of apparatus employed. General details of a routine method of handling this part of the laboratory organization are given. G. R. N.

565. Designs for Laboratory Fractionating Columns. J. H. Simons. *Industr. Engng Chem. Anal.*, 1938, **10** (1), 29.—Designs and descriptions are given for four total reflux columns made entirely of glass and containing small glass rings of improved type. These columns are for liquid partition take-off, vapour partition take-off, moderately low temperatures (about − 5° C.) and moderate pressure (up to 5 atmos.), respectively. A feature of these columns is the avoidance of the use of stop-cock grease. A fifth column for low temperature distillation is also described. G. R. N.

566. Laboratory Extraction Apparatus and its Use in Separating a Lubricating-Oil Fraction with Acetic Acid. S. T. Schicktanz. *Bur. Stand. J. Res., Wash.*, 1938, **20**, 83–86.—The paper describes a glass laboratory extracting column operating with reflux for use with solvents denser than the liquid being extracted. Results are given of the extraction with acetic acid of a narrow-boiling fraction of "water white" lubricating oil. D. L. S.

See also Abstracts Nos. 539 and 576.

Motor Fuels.

567. Gasoline–Alcohol Blends in Internal-Combustion Engines. L. C. Lichty and C. W. Phelps. *Indust. Engng Chem.*, 1938, **30** (2), 222.—Data obtained on the relative performance of petrol and petrol-ethyl alcohol blends as fuels under comparable conditions of internal-combustion engine operation show that the power output, thermal efficiency and heat loss to the cooling water, with comparable mixture conditions, do not change appreciably with the addition of ethyl alcohol to the petrol in concentrations up to 20%, except where this addition reduces detonation and permits the use of optimum spark advance.

Based on fuel consumption, it is concluded that: (*a*) ethyl alcohol should cost less than petrol to warrant its use in 10 or 20% blends in engines with optimum compression ratios for present "standard" petrols; (*b*) its cost should be equal to that of "standard" petrol if both the blend and the petrol are used in engines with optimum compression ratios suitable for each of the fuels; (*c*) the blends should cost less than petrol with sufficient lead tetraethyl to permit operation in engines with optimum compression ratios for the blends. E. F. C.

568. Patents on Motor Spirit. N.V. Nieuwe Octrooi Mij. and W. W. Holland. E.P. 477,745, 5.1.38. Stabilizing gasoline by first subjecting crude gasoline to doctor treatment, water-washing and removing the last traces of alkali by means of sodium bisulphite. The gasoline is then filtered through clay to remove turbidity and an inhibitor added, *e.g.* α-naphthol, monobenzylpara-aminophenol.

Anglo-Iranian Oil Co., A. E. Dunstan and S. F. Birch. E.P. 479,345, 31.1.38. Improvement in the production of motor fuel in which an isoparaffin, *e.g. iso*butane or *iso*pentane is condensed with an olefin (with the exception of ethylene) *e.g.* propylene, butenes in the presence of H_2SO_4 at low temperatures to produce saturated *iso*paraffin derivatives—equimolecular proportions of *iso*butane and the selected olefine reacting.

M. P. Youker. U.S.P. 2,104,285, 4.1.38. Combining hydrocarbon gases with hydrocarbon liquids in the presence of molten sodium.

W. A. Craig. U.S.P. 2,104,791, 11.1.38. Refining of motor spirit by contacting it with an aqueous solution of copper chloride in the presence of sodium chloride at refining temperatures.

W. C. Ault and C. A. Hochwalt. U.S.P. 2,105,464, 18.1.38. Refining cracked spirit to remove sulphur and gum-forming constituents using alkaline ferric oxide at 375–425° C., whereby the sulphur impurities are rendered removable by phosphoric acid at 190–200° C. The distillate is then scrubbed with a polymerizing agent.
W. S. E. C.

Gas Oil, Diesel Oil and Fuel Oils.

569. Cracked Gas Oils for Diesel Fuels. H. Bottomley. *Refiner*, 1937, **16** (9), 424.—Four gas oils, one straight-run and the remaining three from cracked sources, were tested in a Fairbanks–Morse two-stroke 12 × 15-inch vertical single-cylinder solid-injection engine. Their S.V. viscosities at 100° F., calculated diesel indices, approximate cetane numbers and characterization factors were, respectively, no. 1—42 secs., 49·6, 60, 11·6; No. 2—55 secs., 23·9, 40, 11·1; No. 3—36 secs., 28·8, 45, 11·4; No. 4—108 secs., 15·9, 35, 10·2. No. 1 started easily and gave excellent operation. No. 2 performed satisfactorily, gave a slightly darker exhaust and slight pounding. No. 3 was intermediate to Nos. 1 and 2. No. 4 gave considerable starting trouble, a dark exhaust and marked pounding. Loping of the engine under no load was excessive. The respective ignition pressures for the four fuels were 394, 405, 408 and 406 lb. per sq. in., the maximum pressures being 627, 626, 647 and 679 lb. The indicator cards showed regions of slightly delayed combustion for fuel No. 2 and uneven burning in the case of fuel No. 4. In lb. per b.h.p. hour fuel consumption was least for the straight-run and most for the highly cracked stock. The gallonage per hour was closer, being 2·61, 2·63, 2·77 and 2·70. It is concluded that the first three oils are satisfactory, but the straight-run is at a disadvantage because of its premium price. It is advocated that in the interests of economy diesel users should investigate the performance of cracked fuels. G. R. N.

570. Fuel Oils for Diesel Engines (Petroleum and Shale Oils). British Standard Specification No. 209—1937.—The revision of this specification was authorized by the Oil and Petroleum Industry Committee in 1935 in order to bring the specification into line with modern requirements. The development of the high-speed diesel engine has led to a demand for higher grades of fuel than those specified in the 1924 issue, and accordingly the present specification includes a grade of oil suitable for engines for automotive and allied purposes of speeds in excess of 800 r.p.m., in addition to other grades for medium- and slow-running engines.

A minimum limit is set for aniline point as a tentative test for ignition quality (for fuel of petroleum origin only) pending the development of an engine test. H. C. R.

571. Fuel Oils for Burners (Petroleum and Shale Oils). British Standard Specification No. 742—1937.—The specification, the preparation of which was authorized by the Oil and Petroleum Industry Committee in 1935, provides for two grades of fuel oil for domestic purposes, two for marine purposes and four for industrial purposes.

The limits for viscosity range from 45 secs. (Redwood No. 1 at 100° F.) in the case of the domestic fuel to 7000 secs. (Redwood No. 1 at 100° F.) for the heaviest grade for industrial use. With the exception of the domestic grades, no definite limits are laid down for pour point, ash and sulphur contents. H. C. R.

572. Patent on Fuel Oil. G. M. Whitney. U.S.P. 2,104,919, 11.1.38. Stabilizing black fuel oil to prevent formation of sediment in storage by blending cracked residues with straight-run residue which has been subjected to an oxidation treatment prior to blending. W. S. E. C.

Lubricants and Lubrication.

573. Extrusion, Penetration and Oil Content Relationships of Greases. H. R. Shawk. *Refiner*, 1937, **16** (9), 409.—It is concluded that a definite relationship exists between penetration values (A.S.T.M. cone) and the length of the extruded column required to produce fracture. This relationship is independent of the soap base and of the mineral oil used in the grease. It is also shown that the penetration bears a linear relationship to the mineral-oil content, regardless of the soap base or of the type of oil used in compounding. Finally it is shown that extrusion and mineral oil content may be represented by a straight line when plotted in semi-logarithmic scale. The uses of these relationships in making up to specification and in rapid approximate analysis are indicated. G. R. N.

574. Hypoid Gears, Axles and Lubricants. W. A. Witham. *J. Soc. aut. Engrs*, 1937, **41** (5), 509–513.—The mechanical development and construction of hypoid gears are discussed. The testing of extreme pressure lubricants is carried out at the works of the author's firm on a specially designed engine, which is in the form of a four-square axle testing machine, but using only two axles to form a closed system. A torque load is applied by means of a wind-up mechanism, and the system is rotated by means of a motor. Two standard production hypoid axles are used for the test. The machine is brought up to a speed of about 25 m.p.h., and then the load is applied. The test is run with the load on the drive side of the gears until the temperature reaches 200° F., and on the coast side for 8 hrs., holding the temperature of the oil in the axle to a maximum of 200° F. by water-cooling. Results obtained by this means correlate closely with the findings of road tests and service records. Improvements in the design of hypoid gears have simplified the lubricant requirements. J. L. T.

575. Reclaiming of Spent Lubricating Oils. E. Norlin. *Tekn. Tidskr.*, 22.1.38 (Automobil- och Motorteknik No. 1), 3–6.—Discussion of the German reclaiming processes and their applicability to Swedish conditions. From purely commercial aspects reclaimed oils must be comparable in appearance with new oils in order to permit sales at profitable prices. Technically, distillation is required to remove gasoline and gas oil dilution and spindle oil, the latter usually present because of the practice to dump flushing oil in the same container as spent oil. It is also usual to dump used gear oils as well as used greases, together with spent motor oils. It is also considered necessary to treat spent oils with acid, followed by neutralization and filtration, in order to avoid coking and sludging when subsequently used. However, in many cases practical experience has demonstrated that large consumers, who control their methods of dumping, etc., may obtain satisfactory results with very simple processes.

Economic conditions in Sweden at the present time are not such as to necessitate legislative action in regard to compulsory reclaiming of motor oils, but it is stated to be desirable to develop local reclaiming industries for military purposes. R. F. S.

576. Testing Lubricating Greases. R. R. Mathews. *Refiner*, 1937, **16** (10), 470.—A short discussion on the existing methods of testing lubricating greases and of the work in progress to render them more significant. The following are noted: dropping point, consistency, water content, penetration test, B.E.C. bearing test, Wright and Lutz oxidation test, and special tests such as those carried out on the S.A.E., Timken, and Falex machines. G. R. N.

577. Patents on Lubricating Oil. Standard Oil Development Co. E.P. 477,663, 4.1.38. Refining hydrocarbon oil obtained by dewaxing petroleum distillates, by air-blowing the oil at 400° F. until the reaction ceases and then subjecting the oxidized oil to acid and then clay treatment at 300° F.

Röhm and Haas Co. E.P. 477,888, 5.1.38. Dewaxing hydrocarbon oils using methylamine.

C. Ockrent, D. W. F. Hardie and I.C.I., Ltd. E.P. 477,923, 10.1.38. Manufacture of oily condensation products for imparting colour and fluorescence to lubricating oils by condensing an aromatic hydrocarbon with a chlorinated long chain aliphatic hydrocarbon.

W. V. Gilbert. E.P. 478,273, 17.1.38. Addition of a manganese compound, *e.g.* manganese oleate, to lubricants, to inhibit corrosion.

N.V. de Bataafsche Petroleum Mij. E.P. 478,927, 27.1.38. Manufacture of highly viscous products by polymerization of fatty oils, using boron trifluoride as catlayst. The polymerizate is dissolved in gasoline or benzine before treatment with alcohol and/or ketone—the latter solvents being used to remove free organic acids formed during the polymerization.

N.V. de Bataafsche Petroleum Mij. E.P. 478,928, 27.1.38. Stabilizing highly viscous products as prepared (*cf.* E.P. 478,927), by adding a lubricating oil or grease.

50–300 pts. by weight of lubricating oil or grease calculated on 100 pts. by weight of the viscous product.

C. Ockrent, D. W. F. Hardie and I.C.I., Ltd. E.P. 478,972, 27.1.38. Manufacture of lubricating oils by condensing chlorinated paraffin wax with benzene or toluene in the presence of anhydrous aluminium chloride to form two layers. The top layer is removed to recover the oil, and the lower layer is used with or without the addition of aluminium chloride for further condensation.

M. Pier, W. Hirschberger and H. Lemme. U.S.P. 2,104,097, 4.1.38. Lubricant comprising a lubricating oil and 0·05–3% of a residue solid at room temperature and derived by vacuum distillation from a de-asphalted destructive hydrogenation product of a mineral coal.

D. Stryker and J. H. Grahame. U.S.P. 2,104,379, 4.1.38. Solvent refining of hydrocarbon oil using propane.

R. E. Manley. U.S.P. 2,104,567, 4.1.38. Dewaxing lubricating oil by centrifuging.

B. G. Aldridge and E. G. Ragatz. U.S.P. 2,105,874, 18.1.38. Prevention of corrosion in the distillation of hydrocarbon oil in which the oil is heated in a heating zone and caustic soda is flashed into the centre portion of the heated oil stream, and the oil withdrawn from the heating zone.

M. G. Levi, A. Mariotti and I. Ciarocchi. U.S.P. 2,106,010, 18.1.38. Regeneration of used lubricating oil by intimately mixing the oil with powdered anhydrous aluminium chloride and heating the mixture to 130–140° C. to precipitate impurities and sludge. The sludge is removed and the separated oil treated with a decolorizing and de-acidifying agent at 150° C.

R. E. Stanton. U.S.P. 2,106,071, 18.1.38. Decolorizing lubricating oils (viz. removing asphaltic and ceresin compounds) by heating the oil with propane under pressure and at 100–125° F. Suspended matter is removed by passing the solution through a bed of inert filtering medium and the oil decolorized by passing it continuously through a bed of adsorbent decolorizing medium.

H. Zorn and W. Rosinsky. U.S.P. 2,106,232, 25.1.38. Production of lubricating oils of high viscosity index by mixing lubricating oil capable of undergoing chemical condensation in the presence of a Friedel–Craft reagent with *iso*butylene and polymerization products of high mol. wt., and condensing the mixture further in the presence of a Friedel–Craft reagent. W. S. E. C.

See also Abstract No. 529.

Asphalt and Bitumen.

578. Molasses in Road-Making. Anon. *Chem. Tr. J.*, 11.3.38, **102**, 198.—In the *Indian Trade Journal* of Feb. 10, R. C. Srivastava describes experiments made by the Imperial Institute of Sugar Technology, Cawnpore, on the conversion of molasses into an insoluble resinous material suitable for use as a road-making material. The process consists of complete dehydration of the molasses by concentration until it can be drawn into strings, adding dilute H_2SO_4 and heating until the temperature rises to 210–230° C. A mixture of 16·5% (on the concentrated molasses) of asphalt and of tar is melted and treated with diluted acid. Into the mixture is run the acidified molasses, with constant stirring. Heat is continued until the product is insoluble in water as a result of the interaction of carbohydrates and phenolic bodies. The resulting material is a paste easy to handle and suitable for application to stone. It is applied in the liquid condition, does not melt on the road in summer, does not wear away in heavy traffic and is cheaper than other asphalt preparations. To protect the top surface from peeling it should be sealed with a solution of 1 lb. of molasses–asphalt–tar composition in 1 gall. of tar. C. L. G.

579. Patent on Asphalt. C. C. Webb. U.S.P. 2,106,583, 25.1.38. Apparatus for producing asphalt from residual petroleum oils by oxidation. W. S. E. C.

Wax.

580. Physical Properties of Paraffin Wax. R. Fussteig. *Refiner*, 1937, **16** (10), 472.—After outlining the investigations by various workers on the physical states of paraffin wax, the writer concludes from his own studies that in heavy or slop wax distillate it is enclosed in two protective films. The outer film contains resinous compounds, whilst the inner film consists of highly viscous bodies. Under these conditions paraffin wax can be regarded as amorphous. Removal of the outer film induces crystallization in the plate form, and extraction of the inner film allows the wax to crystallize as needles. This latter form is considered the most satisfactory for both pressing and sweating. In producing a wax distillate the author suggests that three cuts should be taken from the distillation unit. The first distillate cut contains no inhibitors, and the wax is in needle form, so this cut can be pressed in the normal fashion. The second cut contains plate crystals and is not suitable for pressing. It was found that shock chilling with water gave a slack needle wax suitable for sweating and an oil–wax mixture that could be recycled. A fractionating chiller to carry out these operations is described. The third cut contains the paraffin in the "amorphous" form, and this is mixed with the oil–wax mixture from the second cut. Slack needle wax suitable for sweating is obtained from this blend by shock chilling, using benzole-phenol (95/5) instead of cold water. It is claimed that this method gives an increased yield of paraffin wax. G. R. N.

Special Products.

581. Organic Chemicals from Petroleum and Natural Gas. M. B. Cooke, C. R. Wagner and H. R. Swanson. *Refiner*, 1937, **16** (9), 426.—A paper presented at the Second World Petroleum Congress, Paris, dealing with the historical aspect of organic chemical production, chiefly from coal and its derivatives, and with the methods that can be used at the present time to convert petroleum fractions into suitable base products for the manufacture of organic chemicals. Stress is laid on the suitability of the pyrolysis–polymerization process and on the future promise of catalytic processes. G. R. N.

582. Patents on Special Products. G. W. Johnson. E.P. 478,317, 14.1.38. Production of oxidation products from paraffin hydrocarbons of high mol. wt.—*e.g.* paraffin wax—by oxidizing the hydrocarbons at 115° C. using as catalyst sodium permanganate.

Röhm and Haas Co. E.P. 478,604, 21.1.38. Manufacture of polythiocyano-derivatives of neutral esters for use as insecticides.

N.V. de Bataafsche Petroleum Mij. E.P. 478,841, 26.1.38. Process for the manufacture of hydrocarbon mixtures containing a high percentage of alkenes of high mol. wt.

Standard Oil Development Co. E.P. 479,017, 19.1.38. Preparation of polybasic acids by subjecting hydroformed naphthas from petroleum distillates to vapour phase oxidation at 200° C. using V_2O_5 as catalyst, or to liquid phase oxidation using as catalyst manganese naphthenate or mercury acetate.

L. R. Coleman and G. L. Cowley. U.S.P. 2,105,856, 18.1.38. Preparation of insecticidal oil, non-toxic to vegetation, from a distillate fraction from crude petroleum oil of viscosity 65–200 sec. Saybolt at 100° F., sp. gr. 0·9000–0·9600, which distils between 500° and 800° F. and yields an unsulphonated residue of 60–85%. W. S. E. C.

Detonation and Engines.

583. The Mechanics of Flame and Air Jets. R. F. Davis. *Fuel Econ.*, 1937, **13** (147), 533–538.—The article presents extracts from a paper read before the Institution of Mechanical Engineers in November 1937.

Collating practically all extant information available through research, experience and modern practice, this is the first treatise of its kind dealing comprehensively with the subject. T. C. G. T.

584. Supercharging of the Compression Ignition Engine for Road Vehicles. L. Pomeroy. Diesel Eng. Us. Ass. S. 143.—In a discussion on the general advantages of supercharging, and in particular the possibilities in its application to compression ignition engines for road vehicles, it is shown that the two major problems to be contended with in the latter field are the wide loading and speed ranges of the engine. For normal purposes, therefore, a road-vehicle engine supercharger must be capable of optional engagement or of variable delivery. The relative merits of well-known makes of superchargers are outlined in regard to adaptability to road duty; among the designs illustrated or described are the exhaust and engine-driven centrifugal types, the Roots and vane type blowers. In an example of the latter design the variable delivery principle has been successfully incorporated. The author suggests that the continuously engaged supercharger has a special application where a vehicle is operated at high altitudes, and he considers that the optional engagement supercharger deserves wider use when there are conditions of continuous long climbs or possibilities of momentary high power outputs being required in emergency. E. F. C.

585. Effect of Operating Conditions and Fuels on Diesel Engine Deposits. J. R. MacGregor and W. V. Hanley. *Oil Gas J.*, 20.1.38, **36** (36), 90.—In order to study the last phase of the combustion process, four methods have been investigated in the laboratory of the Standard Oil Co. of California. The one which is considered in detail is the inferential method of testing a variety of fuels under various controlled engine conditions and studying the resulting engine deposits as an indication of completeness of combustion. Besides studying the combustion process, it was desired to develop an accelerated method in the laboratory service engine used which would correlate with deposits in other popular service engines. The type of engine most subject to formation of deposits was first ascertained, and by test a lubricant selected which would contribute least to engine deposits. The results of various preliminary tests to investigate effects of variations in load, intake air temperature, jacket temperature, lubricating oil temperature and throttling of intake air to simulate altitude operation on the rate of formation of deposits are given.

From these preliminary tests the conditions selected for the accelerated method of test were: Load, idle; speed, 800 r.p.m.; altitude, 5000 ft.; duration, 24 hours; jacket temperature, 150° F.; lubricating oil temperature, 130–160° F. Increase in duration from 24 hrs. to 300 hrs. increases exhaust passage deposits, but has little effect on chamber deposits. Check tests over a four-month period on a straight-run distillate fuel showed satisfactory repeatability.

Special distillates of varying volatility were prepared from a normal fuel to investigate the effect of volatility on the magnitude of deposits under these conditions. The average volatility computed from the 20% and 80% A.S.T.M. distillation temperatures gave the best correlation with amount of deposit, increased average volatility giving smaller deposits. The Conradson carbon value of residual type fuels appears to correlate satisfactorily with amount of deposit, but for distillate fuels the Conradson test is not sufficiently sensitive. The Conradson test on 10% bottoms showed fair correlation for distillate fuels only. A fair correlation was found for all the fuels tested, including straight-run, cracked and doped fuels between engine deposits and cetane numbers when determined by the magnetic pick-up delay method. With cetane numbers determined by the C.C.R. method, correlation was less exact. It is concluded that in diesel engines which are critical to fuel deposition a decrease in operating temperature and load or an increase in altitude increases the quantity of deposits formed. In these engines increasing the average volatility or the cetane number of the fuel decreases the deposit. A direct-injection engine known to be critical to fuel-deposition characteristics was used in these tests. Comparative tests of the fuels used in other engines—for example, a certain pre-combustion chamber type—showed poor correlation with results in the first engine. It is concluded that in those engines in which fuel deposition is slight no consistent difference between fuels and no correlation with physical properties of the fuels are apparent. The tests, covering a wide variety of engine designs, fuels and operating conditions, have demonstrated that the engine designer has greater control over the quantity of deposits formed in the engine than either the fuel refiner or engine operator, as indicated by the test results presented, in which the ratios of deposits were 20 to 1 between extremes in engine design, 10 to 1 in operating conditions and 3 to 1 between extremes in distillate fuels. R. A. E.

586. Effect of Carburetion and Manifolding on Fuel Knock Values. E. Bartholomew, H. Chalk and B. Brewster. *Oil Gas J.*, 13.1.38, **36** (35), 53; *Nat. Petr. News*, 26.1.38, **30** (4), R–31.—Since the 1932 and 1934 Uniontown tests, road ratings have tended to deviate increasingly from the consistent pattern which characterized the earlier ratings. Differences between research and motor method ratings of a fuel are also no guide to car performance as illustrated by test results on two specially blended fuels.

Changes in engine design which may have a bearing on these observations are: (1) considerably lower intake manifold velocities in the low-speed range of the engine, to which knocking is now generally confined; (2) the automatic choke; (3) decreased mixture heating by exhaust gases and the use of automatic heat-control valves; (4) elimination of thermostatically controlled radiator shutters. In addition, there is the possible effect of recent developments in gasoline production, such as polymerization, reforming and new cracking methods.

A review is given of work recently carried out in the laboratories of the Ethyl Gasoline Corporation designed to: (1) find the explanation for some of these unusual performances of fuels; (2) develop improved instrumentation for analysis of events in the intake manifold and cylinder; (3) ascertain principles of selection of fuels most suited to any given set of conditions.

The sampling of the mixture within each cylinder has been made possible by means of a combined sparking-plug and gas-sampling valve, the construction and operation of which are described. Air–fuel ratios for individual cylinders of a certain car during acceleration at 10 to 15 m.p.h. at an atmospheric temperature of 56° F. show variations between 11·56/1 and 16·01/1. The principal reason seems to be that some cylinders may receive substantially only air and lighter fuel fractions, leaving the manifold in the vapour state; others may receive in addition liquid heavy ends in approximately the same air–fuel ratio as that of the mixture leaving the carburettor; still others receive additional liquid heavy ends which, under conditions of perfect distribution, would have entered the first-mentioned cylinders. With a view to examining the effect of non-uniform distribution in the laboratory engine, the C.F.R. manifold was modified in such a way that unvaporized fuel could be bled from the manifold, the proportion being controllable and measurable, and the mixture subsequently entering the cylinder heated to any desired temperature. The arrangements are described. The three-cylinder conditions mentioned above can thus be simulated. The distribution of anti-knock value throughout the distillation range of a fuel may also be directly determined, and results given show that fuels fall into three categories—viz. those the cuts of which by simple distillation from the 50 to 100% points have: (1) approximately the same value as the first 50% cut; (2) constantly increasing anti-knock values; (3) constantly decreasing anti-knock values. For lead-free fuels, those of the third classification are by far the most numerous, those of the first classification are occasionally encountered, those of the second class are not available commercially. Fuels of the third classification may be changed to the first by addition of T.E.L.

By means of the modified manifold it is also possible to ascertain critical compression ratios (C.R. for knock meter reading of 50) on the basis of constant carburettor air–fuel ratio, for varying percentages of fuel delivered by the carburettor which leave the manifold in the vapour state. Curves for each of the three cylinder conditions, obtained by similar methods as before, may thus be determined, and results obtained for three fuels are illustrated. The combined effects of air–fuel ratio and anti-knock value of the fuel entering the cylinder are thus ascertained. Cylinders receiving fuel of high anti-knock value, for reasons of imperfect distribution and type of fuel used, may give more knock than others receiving fuel of lower anti-knock value, depending on the respective air–fuel ratios.

Other tests showed that between the limits of no heat and complete vaporization of fuel, the mixture, at any fixed temperature leaving the manifold, contains a greater fraction of the fuel delivered by the carburettor in the vapour state when heating is accomplished by hot spot than when heat is supplied to the carburettor air.

The relative knocking tendency of cylinders of a multi-cylinder engine varies with carburetion and fuel distribution as described, provided spark advance and cylinder cooling are uniform. Variations in knocking among the cylinders due to differences in cooling are believed to have been minimized in recent engines. Variations in spark advance create a greater problem, but recently an instrument capable of measuring the ignition advance of each cylinder simultaneously has been devised. This is described and illustrated.

It is apparent that with all the possible variations in carburetion, fuel distribution, etc., in engines of the present day, no single set of carburettor and manifold conditions for the laboratory engine theoretically should give ratings equal to the average of ratings obtained on several cars. The development of a correction factor applicable to all types of fuel and capable of direct determination on the engine would be desirable.
R. A. E.

587. Fuel Systems of 1937 Automobiles. T. W. Legatski and R. R. Couch. *Refiner*, 1937, **16** (11), 537.—A new procedure for rating fuel systems was developed for the Pawhuska tests conducted by the W.P.R.A. and N.G.A.A. conjointly. Test runs on nine cars were carried out at various atmospheric temperatures, using a standard fuel, its vapour pressure being varied. The "vapour locking vapour pressure" was taken as the highest vapour pressure which permitted a car to start and accelerate to 55 m.p.h. after a 5-minute stop succeeding an extended driving period at constant speed. The method was accurate, but time-consuming before complete data were obtained. Three alternative fuel systems, duplicate runs, a very volatile fuel, etc., were tried. Evaporation losses from the fuel systems were assessed on a gravity basis —a change of 1° A.P.I. indicated a 3·5% volume loss. Octane losses were shown to be one octane number per 1° A.P.I. gravity loss or 0·25–0·3 octane numbers for every 1% volume loss. Permissible vapour pressure was plotted against temperature for each of the test method variations on each of the cars. The agreement between the conventional method and the three alternative fuel systems was good. In some cases a comparison of the curves for the same car of the standard and the more volatile fuel showed lower permissible vapour pressure with the latter. Since such a result is due to the loss of vapours from the fuel system, the use of this more volatile special-reference fuel shows promise for distinguishing between fuel systems. Study of the vapour loss data suggested that over-all losses from the system will range from 4% to some higher value, depending on the type of driving. G. R. N.

588. Loss of Methanol Anti-freeze in Automobile Cooling Systems. H. C. Duus, E. H. Keller and H. M. Cadot. *Industr. Engng Chem.*, 1938, **30** (2), 142.—Due to the popular view held that a volatile anti-freeze evaporated to leave a less concentrated solution in the cooling system, users of methanol for this purpose have often incorrectly made good losses with straight anti-freeze; this has resulted in lowering the boiling point and increasing "after-boil" losses. By a series of practical tests made in three hundred cars over the past seven years, it has been shown that losses in engine cooling systems equipped with 140° F. (60° C.) thermostats supplied by the motor manufacturers, are mainly due to mechanical causes such as leaks, "after-boil" or carrying over of fine spray through the overflow with both volatile and non-volatile anti-freezes. The losses due to evaporation are so small as to have no significant practical effect, and the freezing point may therefore be maintained by replacing losses with methanol solution of the same concentration as was originally put into the cooling system. E. F. C.

589. Trend towards Gasoline-Powered, Low-Priced Farm Tractors. J. W. Thomson. *Nat. Petrol. News*, 2.2.38, **30** (5), 36.—Statistics indicate that the 1,200,000 tractors in the U.S.A. consume 4,000,000,000 galls. of fuel per annum, and that the farming community, in addition, owns 18% of the automobiles and 26% of the trucks in the country. The desire for extra power and speed is causing a steady increase in the adoption of gasoline-engined units. The advantage gained is by virtue of: (1) much higher compression ratios are possible owing to the better anti-knock characteristics of the fuel; (2) lower intake manifold temperatures. It is stated that the conversion to gasoline fuel from distillate (kerosine) fuel may involve increases of as much as 30% in draw-bar pull and 45% in belt power. Some 30% of the tractors now in use in the U.S.A. are operating on gasoline. H. G.

590. Field of the Suction Gas Vehicle. Anon. *Fuel Econ.*, 1937, **13** (147), 543–547.—In suggesting that Government aid ought to be forthcoming for this type of vehicle, the article has obtained the views of interested parties.

While it is acknowledged that at present, without Government concessions, the

vehicle is not an economic proposition, it is claimed that H.S.G. (*i.e.* high-speed gas-producer) trucks, produced in reasonable numbers, would cost only £50 more than a similar capacity petrol vehicle and less than a diesel. Such vehicles would show a saving of £1 per diem with a 5–6-ton pay-load.

75% anthracite and 25% charcoal is found to be an excellent fuel for the H.S.G. producer. Fuel costs of this type of vehicle can be as favourable as 0·355*d.* per mile, against 1·38*d.* per mile for petrol, although details of a 1096-miles trip from Inverness to London and return show fuel costs per mile to be: producer gas 0·72*d.*, diesel 1·0*d.*, petrol 1·93*d.*

The article calls for a higher gross weight concession, as vehicles operating on producer gas will on an average be 1 ton heavier than petrol lorries, this increase being due to heavier fuel load necessary as well as the producer plant.

The Sentinel Wagon Co. apparently see great possibilities in this vehicle on its commercial merits alone, and it is believed that improvements that are bound to appear will make the vehicle a success. T. C. G. T.

Coal and Shale.

591. Scottish "Oil from Coal" Third Report. Anon. *Fuel Econ.*, 1937, **13** (147), 540–541.—This article analyses the above Report, which includes an account of an investigation, conducted by a specially appointed Coalmasters Sub-committee, to obtain more definite information on the demand for smokeless fuel in Scotland, and the relation of this demand to the practicability, from an economic point of view, of setting up plants for the manufacture of this material.

The report, which is unfavourable towards smokeless fuels, infers that none of the latter are produced at an economic figure under present-day conditions. The Duke of Montrose dissociates himself from the Committee's findings, particularly as regards the economics of smokeless fuel, and he cites the Low-Temperature Carbonization Co., Ltd., as an example of profitable business in this fuel.

The Report advocates Government aid for Scottish production of oil by processes which completely convert the coal into oil and leave no solid by-product to be marketed.

It is emphasized that the Report deals only with Scottish conditions, and it is pointed out that there are available in Scotland classes of coal suitable for any of the known processes for complete conversion into oil. T. C. G. T.

592. Scottish Shale Oil Industry. Anon. *Petrol. Times*, 15.1.38, **39** (992), 81.—The better market conditions for spirit and light diesel oil in 1937 have justified considerable expenditure on mines and works. Two new pits have been opened near West Calden, underground haulage and drilling equipment have been modernized, and considerable improvements in workers' conditions have been made possible. The manufacture of bricks from spent shale is making very satisfactory progress. The markets for sulphate of ammonia have been badly curtailed by the events in Spain and the Far East, but other promising outlets are being explored. H. G.

593. Preparations made for Mining Oil from California Deposit. T. P. Sanders. *Oil Gas J.*, 3.2.38, **36** (38), 40.—About twelve miles south-west of Santa Maria, California, a deposit of diatomaceous earth, impregnated with oil, is to be mined. Experimental work has been carried on and several tons of the material have been produced. Plans now call for a large-size plant of the same design as the experimental one that has given such good results.

Mining will be done with a steam shovel, using dynamite to dislodge the ore. The plant will handle 500 tons per day, and will operate as a continuous process.

A method has been devised for feeding the diatomaceous earth into the furnace without admitting air. A yield of 64 galls. of oil per ton has been obtained experimentally.

It is stated that sufficient oil impregnated material for 150 years, used at the rate of 10,000 tons per day, exists in this area. L. V. W. C.

Economics and Statistics.

594. Fuel Consumption and the 1935 Census of British Industry. Anon. *Petrol. Times*, 15.1.38, **39** (992), 69.—In classified tables the annual consumption of all types of fuel by various branches of British industry are listed. The figures are taken from the 1935 census, and are adjusted to exclude fuel used for conversion into other forms of fuel and in the form of industrial gas. From this it appears that during that year the coal equivalent of fuel oil was 1·7% of the total on a weight basis, a proportion which represents 4·3% of the total cash value. The latter figure, however, includes the fuel oil tax of 1*d.* per imperial gallon. It is therefore evident the coal industry suffers but little from the use of oil as industrial fuel. Even in the petroleum industry itself more coal than oil was used as fuel. The article is, in the main, an argument for the abolition of the fuel-oil tax. It is pointed out that the tax is a heavy burden on the lighter manufacturing industries, where fuel oil, despite its higher cost, possesses overwhelming advantages over coal. In these industries the tax has not become a factor determining the users' choice of fuel, and does not affect the coal industry at all. H. G.

595. Italian Petroleum Policy. A. Giarratana. *Monit. Petr. roum.*, 1937, **23**, 1781–1784.—This paper deals with the development of national sources of supply of motor fuel and other petroleum products in Italy. In the search for petroleum the State has spent 150 million lira in Italy, with little success, whilst the State Railway has spent 170 million in Albania, where the production of crude in 1937 was 180,000 tonnes; it is estimated to reach 300,000 tonnes in 1938. The State-owned Company, A.G.I.P., has obtained over 400,000 tonnes of crude from concessions in Roumania. Attention has been devoted to production of alcohol for use in motor fuel, from wine and beet, and although supplies fell short of the estimated yield, 370,000 hectolitres were produced in 1937; this may be increased to 500,000 hectolitres in 1938, and the programme aiming at production of one million hectolitres yearly will be speeded up. Expansion of the refining industry has been encouraged by granting concessions for production of motor fuels, and in 1924 a Customs rebate of 350 lira per tonne of white products obtained from crude materials by any process was allowed; further concessions were granted in 1926 for treatment of residues, and as a result cracking plants were constructed at Spezia, Naples and Marghera which, commencing in 1930 with 50,000 tonnes of motor spirit, will produce 230,000 tonnes in 1937. These concessions cost the State 100 million lira a year and, until the tax on motor spirit was increased, benefited cracking plant operators to the extent of 800 lira per tonne of motor spirit produced. In 1933 the concession for treatment of residues was reduced in an attempt to foster the production of all types of petroleum products, and in order to compensate producers of motor spirit from Italian crudes, the State paid 7,115,680 lira in 1936. With the completion of the installations at Livourne and Bari, the construction of which was undertaken as a result of concessions granted for development of hydrogenation processes, it is estimated that supplies of motor spirit sufficient for normal needs, as well as other products, will be obtainable from Albanian crude and from shales and lignite. Consumption of motor spirit decreased from 460,000 tonnes in 1935 to 300,000 tonnes in 1936 as a result of increased price during the sanctions period; the consumption for 1937 is estimated at 400,000 tonnes. It is stated that in 1938 all public vehicles and certain vehicles operated by the State and local authorities, 7000 in number, will be compelled to use a national carburant, which may be electricity, alcohol blends, gazogene, methane or materials of Italian origin. Contracts have been signed for the supply, at a Mediterranean Port, of Irak crude at a price lower than the prevailing world price for crude of similar quality. Figures for import and production of all products over a number of years are tabulated. A. O.

BOOK REVIEWS.

The Science of Petroleum. Editors: Dr. A. E. Dunstan, Professor A. W. Nash, Dr. B. T. Brooks and Sir Henry Tizard, K.C.B., F.R.S. Four Volumes. Pp. 1–3192; 11″ × 8″. (London; New York and Toronto: Oxford University Press.) £15 15*s.* net.

A preliminary announcement of this work stated: "There is a great need for an authoritative work of reference on the general and particular application of science and scientific method to the mineral oil industry." In one's first approach to the "Science of Petroleum" it is natural to compare it with the select few of its predecessors which have attempted an encyclopædic survey of the entire industry, viz., Redwood's *Treatise*, Day's *Handbook* and Engler–Hofer's *Das Erdol*. Redwood was first published in 1896. The fourth and latest edition is 1922. Day's *Handbook for the Petroleum Industry* was published in 1922. *Das Erdol*, by Engler and Hofer, appeared at intervals in four volumes between 1909 and 1916, and was followed in 1925 by two economic and statistical volumes, *Die Erdolwirtschaft*. Thus, for about fifteen years, no work of reference has been published touching the entire field of the petroleum industry.

During 1933 the possibility of revising Redwood's *Treatise on Petroleum* and bringing it up to date was seriously considered by the Editors. It was apparent that this idea was not a practicable one. The "balance" of the industry had altered completely since Redwood's *Treatise* was planned. The developments in technology had long outstripped the ability of any single author to deal with them. It had become a task of devolution of responsibility to a large number of specialists, followed by editorial integration of the individual sections. Early in 1934 the Oxford University Press was approached with a view to undertaking the publication of an *Encyclopædia of Petroleum*. It was in keeping with the fine traditions of these well-known publishers that their support of the project was willingly given and the resources of the Oxford University Press placed at the disposal of the Editors. Publication thus became a practical proposition, and towards the end of 1934 the task of planning the different sections of the work and arranging contributions from nearly four hundred authors all over the world was initiated. It was the original intention of the Editors to devote a volume to the history and economics of the petroleum industry—legislation, tariffs, prices, distribution, etc.—following the precedent of Volume III of Redwood's *Treatise*. This intention was wisely abandoned. The applications of science to the many and varied aspects of the petroleum industry are sufficiently outstanding to warrant a work devoted exclusively to their exposition. Thus the work evolved as the *Science of Petroleum*, and the whole of its three million words and 3192 pages are true to its title.

In the process of its evolution the work has become considerably more than a work of reference. To describe it as an "Encyclopædia" would be a misnomer. In the Preface the Editors state, "The records of advances in the science and technology of petroleum are scattered in innumerable journals and in the archives of industrial companies. The purpose of the present work is to provide a balanced and comprehensive treatise that shall be critical in treatment...." They could have stated with justice that all these "scattered records" have been brought together and made available in a single publication. The individual chapters are, in fact, separate scientific papers, varying in length from 1000 to 40,000 words, planned and arranged in their relationship to the whole. It is well known that a considerable amount of scientific data, whilst of immense value in itself, is often not generally available because it is scarcely sufficient in volume to warrant the preparation of a book or paper on the subject. Such data can be and have been included within the scope of a work planned on the lines of the *Science of Petroleum*. Thus there are chapters on the "Design and Operation of Sea Terminals," "Electrification of Refineries," "Laboratory and Small-Scale Distillation," and over 100 pages (twenty chapters) devoted to analyses and distillation tests of crude oils from the world's oilfields. In making such information generally available, the Editors and contributors have filled many gaps in existing literature.

The four volumes of the *Science of Petroleum* are approximately equal in size. A broad division of the contents is: Volume I, Geology, Production and Trans-

port; Volume II, Chemistry and Physics; Volume III, Refining; Volume IV, Products and Utilization. This rough division, however, does not adequately indicate the extraordinarily detailed sub-division and comprehensiveness which have been achieved. In the section dealing with Physical and Chemical Properties, to take one example, there are six main sub-divisions, dealing respectively with Viscosity, Density and Refractive Index, Spectrographic and X-Ray Application, Optical Properties, Thermal and *P-V-T* Data, and Molecular Structure. Each of these main sub-divisions comprises eight to ten chapters by recognized authorities dealing with a different aspect of the main subject. The section on Molecular Structure, to carry on the illustration, contains chapters which deal with vapour-pressure determination, molecular-weight determination, properties of pure hydrocarbons (giving the structural formulæ and physical properties of 800 hydrocarbons), molecular structure of non-cyclic hydrocarbons, energy of atomic linkages, interfacial tension and dielectric constants. One chapter in each section is usually devoted to a correlation of the problems discussed in the other chapters of that section. As a consequence, there is never any danger of being able to see the trees and not the wood. The reader realizes, however, how vast is the number of trees that go to make up the wood. The whole Table of Contents could, in fact, have been quite easily arranged on the model of the family tree or genealogical table for those who like their data systematized in this form.

The Oxford University Press deserves special tribute for the excellent manner in which the book has been printed and produced. The text is in "Times" Roman type, selected for its great legibility, particularly in tabular matter. The size of the page (11″ × 8″) allows full justice to be done to charts, diagrams and maps, without the annoyance of large numbers of folding plates frequently met with in works of this character. The pages are set in two 3¼″ columns, which again adds to the ease of reading. The illustrations throughout are remarkable for their legibility and clarity of reproduction. When so much is excellent, criticism may appear uncharitable. Nevertheless there are one or two minor details which would have added to the ease of reference. The pagination is continuous from Vol. I to Vol. IV. It would have been an advantage if the first and last pages of each volume had been printed on the binding-cases and "Dust-jackets." The references at the end of each chapter are arranged in alphabetical order of authors' names. This follows American practice, but makes the discovery of a reference in the text a lengthy process, when the chapter is 30 or 40 pages in length. The Index is placed at the end of Vol. IV. For the convenience of libraries and to lessen the wear on Volume IV, it would have been useful to have had the Index in a separate volume. To offset this drawback, however, the Table of Contents has been printed at the commencement of each volume.

The latest prospectus of the *Science of Petroleum* states that "It is proposed to issue supplementary volumes under the same editorship from time to time, when the progress of research and technique makes this necessary." It must not be concluded from this that the *Science of Petroleum* will speedily become out-of-date. Only a relatively small proportion of the work is concerned with the latest details of equipment and processes. The greater part of the work deals with the fundamentals of petroleum science which have become established during the past ten years. As Lord Cadman has indicated in his Foreword, it is the impact of current scientific thought, the continuous application of fundamentals that make for scientific progress.

The Editors, the majority of the Honorary Associate Editors and over one hundred of the contributors are members of the Institution of Petroleum Technologists. The Institution can be justifiably proud of its association with a work which in planning and execution is unique.

Only a general survey of the *Science of Petroleum* has been attempted in this review. The individual volumes are to be reviewed by specialists in this and subsequent issues of the *Journal*.

S. J. Astbury.

The Science of Petroleum. Volume II. Pp. 840–1669. The Chemical and Physical Principles of the Refining of Mineral Oil (being Part II, Sections 18–25).

Part II of the *Science of Petroleum* comprises Sections 18 to 39 of the complete work, and deals with the Chemical and Physical Principles of the Refining of

Mineral Oils. About one half (Sections 18 to 25) of Part II is included in Volume II. The latter half of Part II is in Volume III, and deals with physical and chemical refining processes, solvent extraction, dewaxing, cracking, hydrogenation, and the chemical engineering side of refining.

Volume II, which is the subject of the present review, commences with a section giving the analyses and properties of crude petroleum, each particular producing field being the subject of a separate contribution.

The information available in this section is of extreme value, particularly the tabulated analytical results, and the contributors are to be thanked for the painstaking way in which this work has been carried out. It is very unfortunate, however, that there is no definite system for making and reporting the analyses of crude oils and the perusal of analyses collected from various sources forces the reviewer to realize the urgent necessity for some system of standardization to be applied to the methods, and particularly to the form of tabulation of the results of crude analyses. The fractions cut in different analyses are different; that is to say, some people analyse gasoline up to a certain end-point, and other analyses give figures to another end-point. About half the figures are given in Fahrenheit and about half in Centigrade. This makes it extremely difficult to compare the oils one with another. Gravities are given in A.P.I. degrees, others in specific gravity. Flash points are given both Centigrade and Fahrenheit, whilst lubricating fractions are in some cases reported in different viscosity scales, and there is no definite system for defining light, medium or heavy viscosity lubricants.

Naturally this is not in any way the fault of the contributors or editors; it is purely the lack of standardization at the present time; but from the reader's point of view it certainly makes the assimilation of the results much more difficult, particularly when making comparisons.

As might be expected, the sections dealing with the Mid-Continent, Californian and Gulf Coast crudes are very full, and give a great deal of detailed information. The writer would like to have seen a little more detail in the analyses of crudes in the Trinidad Section.

The section on U.S.S.R. is very complete.

The chemistry of petroleum has been divided into eleven sub-sections handled by thirteen contributors. It contains 120 pages of material. The Chemistry of the Hydrocarbons by Thorpe and Farmer is almost a textbook on organic chemistry in itself. In the reviewer's opinion the chemistry of petroleum is covered more precisely and in greater detail in this section than in any of the existing textbooks. The Hydrocarbons receive nearly half of the section, the remaining subjects being the Chemistry of Petroleum and Petroleum Products, Composition of Cracked Gasolines, Oxy-Compounds, Gum in Gasoline, Industrial Oxidation, Sulphur Compounds, Nitrogen Bases, Inorganic Constituents and Colloidal Chemistry of Petroleum.

The Physical and Chemical Properties of Petroleum and its Products contains approximately 200 pages, handled by a large number of contributors. The main sub-divisions of this section are headed "Viscosity," "Density and Refractive Index," "Spectrographic and X-Ray Application," "Thermal, Critical and P.V.T. Data" and "Physical Properties of Molecular Structure." The whole of this section is very liberally supplied with graphical and tabulated information.

Section 21 describes analytical and testing methods. The History and Development of Refining in the United States is the subject of Section 22, whilst Casinghead Gasoline Extraction and Natural Refinery Gases follow. Some 80 pages on Petroleum Distillation take one to the end of Volume II. This section includes a very comprehensive explanation of the theory and mathematics of distillation, together with charts of the equilibrium constants for several of the simpler pure hydrocarbons. The general features of tube-still design and the various circuit diagrams for single and multi-flash atmospheric and vacuum units, together with typical operating results, are given. Laboratory and small-scale distillation is treated separately in very considerable detail, whilst special naphthas and solvent fractions, together with equipment for fractionation of these, complete this volume.

At the present time there is no doubt that the entire book is the most complete source of information available to petroleum technologists. The amount of work involved has been enormous, and an extraordinarily high degree of quality is shown throughout, for which the editors and assistant editors are to be congratulated. It may appear somewhat heartless to remind them that it is now time to think

about the preparation of future editions, which will in due course become necessary if the present rate of progress in technology research is maintained.

HAROLD MOORE.

The Geology of Egypt. Volume 2, Part 3. W. F. Hume, D.Sc., F.R.S.E., A.R.S.M. and R.C.S., F.G.S. and F.R.G.S. Pp. xxxv + 690 to 990 and Index, pp. 1 to 75. Government Press, Cairo, 1937. Price P.T. 250 (about £2 11*s.* 6*d.*).

This book forms the fourth of the exhaustive geological series written by Dr. Hume for the Survey of Egypt. Volume 1 was published in 1925, with a preface by the late Sir Henry Lyons, D.Sc., F.R.S., who was largely instrumental in establishing the Geological Survey of Egypt in 1896, at the request of Lord Cromer. Dr. Hume is Technical Councillor of the Geological Survey of Egypt, and President of the Royal Geographical Society of Egypt. He has been with the Survey since the second year of its existence, and is eminently qualified to bring together and discuss the material which the Survey has painstakingly collected during the past 42 years, relating to both the scientific and economic aspects of the geology of Egypt. Dr. Hume has himself visited most of the districts described in this book, thus bringing his own observations and personal experience to bear on all he has written—a useful asset when discussing any special subject.

The volume under review deals fully with Egyptian minerals of economic value associated with the intrusive pre-Cambrian igneous rocks and ancient sediments. It includes fascinating chapters on gold and gold-mining in Egypt in ancient and recent times, together with summaries of the characteristics of the gold-mining areas, and there are sections on silver, copper, zinc, molybdenum, tungsten, iron, chromium, nickel, lead, tin, platinum, graphite and other minerals associated with ultrabasic rocks, such as magnesite, asbestos, talc, kaolin. The sections dealing with the mining of minerals of economic value in Egypt have been written in collaboration with Mr. R. H. Greaves, M.I.M.M., formerly Controller of the Egyptian Department of Mines and Quarries.

Chapter 9 is devoted to precious and semi-precious minerals and ornamental or economically useful rocks associated with the pre-Cambrian formations of Egypt, and includes in the first two categories such interesting minerals as peridot, beryl, amethyst, jasper, chalcedony, garnet, lapis lazuli, malechite and azurite. Beautiful examples of bracelets, necklaces, scarabs, beads, amulets and other articles made in the dynastic periods from these minerals are to be seen in any Egyptian museum. Some of the gems were highly valued in ancient times for their talismanic virtues. For example, a peridot set in gold was believed "to dispel the vague terrors of the night," or to afford protection from the wiles of evil spirits if strung on the hair of an ass and attached to the left arm. Speaking of the localities in which garnets have been noted, Dr. Hume says, on page 864, that "garnets may have also been recorded elsewhere by Ball in his volume, but the mineral does not appear in his index." Garnets have undoubtedly been found in other places in Egypt than those mentioned by Dr. Hume. The reviewer, on referring to his own notes on a geological excursion to examine the lower Eocene and Cretaceous formations in Upper Egypt, made in 1922, finds records of the discovery by him (W. H. Cadman) of two outcrops of pegmatite (garnetiferous) hitherto unrecorded. One of these was to the south of Atrun or Sirdar Island, and the other between the east bank of the River Nile, opposite to Elephantine Island and the road to Kurkur Oasis across the Nubian sandstone. Specimens of these outcrops, including a few good crystals of garnets and numerous small brown-red ones, were verified by Dr. Ball, the Director of the Desert Survey, and were noted by him for inclusion in the volume he was then preparing on the South-eastern Desert. Egypt is well endowed with metamorphic and igneous rocks of economic or ornamental value, a fact well known to the ancient Egyptians, who quarried them extensively and employed many of these rocks from predynastic times for monuments, statues, sarcophargi and other objects. Among the most notable of igneous rocks so used are diorite, granite, phorphory, basalt and serpentine, and of the metamorphic rocks, black or green schist, green breccia, slate, marble, and talc or steatite used from Archaic times for beads, scarabs and other small objects, and to-day extensively used by the local Arabs for fireproof dishes, bowls and pipes.

Chapter 10 deals with historical or geological dating, with special reference to Egypt. It describes the bases of ancient Egyptian chronology. Dr. Hume con-

cludes the discussion in this section by stating that "sufficient has been said to indicate that although historical data have been recorded on stone or written on papyrus, there still remain uncertainties as to the dates of events within that period." Sections 2 and 3 of this chapter give the basis of dating of the Stone Age and of Geological Time. As regards Geological Time, Section 3 compares chronology as based on invertebrate fauna, as based on the relative rates of deposition of sediments and as determined by radioactivity. "In dealing with the Historical Period, the dates are believed to be correct within the hundreds of years. For the predynastic dates the doubt rises into thousands, and, as regards the Old Stone Age and the Glacial Period, into the hundreds of thousands, whilst as regards the vast geological sequences preceding these, differences of a few millions of years are considered of little significance."

The volume is printed in clear type and is copiously illustrated throughout. The numerous photographic reproductions in the plates are excellent and some of the illustrations are beautifully coloured. At the beginning of the book is a list of contents, which includes the whole of the subjects in Volume 2, in addition to the contents of the book under review. A few typographical errors have been noted, including the repetition of a whole line by the printers, near the bottom of page 722, and the omission of the correct line required to make sense. There is a comprehensive index at the end, which greatly adds to the value of the book.

Considering that the price of the book is more than £2 10*s*., it is surprising that the Egyptian Ministry of Finance has not provided a more suitable cover; to bind a large and valuable book like this, consisting of more than 400 pages, about 10 ins. by 7 ins., and weighing more than 3 lb., in the standard, thin blue paper covers as used for the cheapest Egyptian Government publications, is quite indefensible. A flimsy paper cover on a book of this size and weight is certain to become detached and torn after the book has been handled a few times. As more of these volumes are to follow, it is to be hoped that the Egyptian Government will remedy this serious defect, and will arrange for future volumes to be suitably bound in stiff cloth covers, more in keeping with the really high scientific value of the contents.

The name of Dr. Hume and the Geology of Egypt are almost synonymous terms; he is the greatest living authority on this subject. Geologists will welcome this volume. It is an accurate record of the greatest geological value, recording in a delightful way the unique researches and life-long scientific studies of the distinguished author, and also the work of his many able colleagues, including the valuable contributions to the Geology of Egypt by Dr. Hassan Sadek Bey, the Director-General, Dept. of Survey and Mines, who was recently made an honorary member of the Institution of Petroleum Technologists. Like the previous volumes, this book will also appeal to the mineralogist, the metallurgist, the Egyptologist and the historian. It will also appeal in no small degree to the general reader who is interested in things Egyptian. Dr. Hume's writings have a literary charm of their own. The reviewer can whole-heartedly recommend this volume to all who take an interest in Egypt's past, present and future. No library should be without a copy.

W. H. CADMAN.

Les Ressources Minerales de la France d'Outre-Mer. V. Le Petrole. By H. de Cizancourt, L. Migaux, L. Dubertret, F. Blondel and J. Filhol. Pp. 249; index, pp. 251–259. Bureau d'Etudes Geologique et Minieres Coloniales, Paris, 1937.

Volume V of the "Mineral Resources of France Overseas," which is entirely devoted to the petroleum industry, forms part of a series of technical publications the object of which is to give an inventory of the mining possibilities in French colonies.

It opens with a short account by M. de Cizancourt of the general characteristics of oil-bearing strata and the methods employed in oil prospecting. In his study, which is not without originality, the author shows that the research for petroleum is essentially a geological problem, owing to the close relationship between the formation of petroleum and the phenomena of sedimentation, and between that of its accumulation and structural evolution. By stressing the observable facts, which permit the distinguishing of petroleum deposits, the author first of all outlines the nature of the different facies.

The mechanism of migration is then described in its different phases, taking into

account both theoretical considerations and the observed facts. In conclusion, a study of the occurrence of oil in the different types of structure is given.

Finally, dealing with the problem of the genesis of petroleum, the author shows that since the conditions reigning during its formation cannot be studied *in situ*, efforts should be made to draw a parallel between the information derived from the petrographic study of oil-bearing strata and the chemical mechanism of hydrocarbon formation.

Following upon this introduction, each colony is dealt with in turn: Morocco, by M. Migaux, who traces the history of the researches carried out and the work undertaken systematically since 1928 both in the Rharb and in the Tselfat regions. The primary results obtained in the Jurassic fold of Tselfat are given in an objective report.

M. de Cizancourt then deals with Algeria and Tunisia. After having described the main features of the stratigraphy and the geological structure of North Africa, he enumerates the location of oil showings. The history of the prospecting, the development of the drilling at Tliouanet (Algeria), and the work now being carried out in Tunisia, are then briefly reviewed.

Gaboon and Madagascar, where researches are also being undertaken, are then described by M. de Cizancourt. A short, succinct account of the geology of these two countries is completed by a description of the prospection methods peculiar to these parts.

The problem of Syria is treated by M. L. Dubertret, head of the Services des Mines in the Mandated Territories, who is one of the instigators of the recent prospections.

To complete the picture, a rapid survey of what is known of petroleum in other French possessions is given by M. F. Blondel.

Although Iraq is not a French colony, its close proximity to Syria on one hand, and the important part it plays in supplying liquid fuel to France on the other, do not allow the presence of petroleum in this country to go unnoticed, and in this connection M. de Cizancourt has drawn up a brief, but concise, review of the search for petroleum in Iraq.

Finally, M. Filhol, of the Office National des Combustibles Liquides, has drawn up a statement of the economics of France's position in regard to petroleum and the world market of this commodity in such a way as to indicate clearly the importance of this question.

This very complete collection of works is given in an attractive form, and can usefully be read not only by geologists, but by all who are interested in one way or another in the petroleum question. H. VAUTRIN.

BOOKS AND PUBLICATIONS RECEIVED.

Committee of Imperial Defence. Report of Sub-Committee on Oil From Coal. Pp. 71. H.M. Stationery Office, London. Price 1*s.* 3*d.*

This Committee was appointed under the Chairmanship of Viscount Falmouth "to consider and examine the various processes for the production of oil from coal and certain other materials indigenous to this country, and to report on their economic possibilities, and on the advantages to be obtained by way of security of oil supplies in emergency." The report is divided into the following Sections: (1) The position in regard to natural oil supplies, (2) the production of oil from home sources, (3) the economic aspect of the home production of oil, (4) the position in time of war, and (5) recommendations. The findings of the Committee have shown that "so long as the price of imported fuel remains in the neighbourhood of the present figure, the case for home-produced oil, judged by purely economic standards, falls to the ground." If, therefore, there is to be further development of the production of oil from coal on any important scale, a continuance of a guaranteed preference on home-produced spirit is essential. The Committee have therefore recommended the continuance of a guaranteed preference for a period of 12 years from 1938, the rate being increased from 4*d.* to 8*d.* per gallon, and the guarantee extended to include diesel oil for use in motor vehicles.

Trinidad and Tobago Disturbances 1937. Report of the Commission. Pp. 120. H.M. Stationery Office, 1938. Price 2*s*.

This comprehensive report of the Commission appointed to inquire into the labour disturbances in the Colony of Trinidad and Tobago contains useful information on the present economic position of the Colony, both agricultural and mineral. Considerable space is devoted to an account of the social services of the colony, viz. medical and health, housing, education, land settlement, and to labour legislation and administration.

The Committee conclude that the true origin of the disturbances was the more or less general sense of dissatisfaction among the workers for which there was no adequate means of articulation through recognized machinery of collective bargaining.

Properties of Typical Crude Oils From Fields of the Eastern Hemisphere. By A. J. Kraemer and E. C. Lane. U.S. Bureau of Mines, Bulletin 401. Pp. iv + 164; index, pp. 165–169. Superintendent of Documents, Washington, D.C. Price 20 cents.

This bulletin contains comments, tabulated data, and individual analyses of 142 samples of crude petroleum obtained from Albania, Czechoslovakia, France, Germany, Great Britain, Italy, Poland, Roumania, Yugoslavia, Greece, Russia, Iran, Iraq, India, Japan, East Indies, New Zealand, Algeria, Egypt and Angola. Information that has been obtained indicates that most of the samples were taken directly from wells or from field storage tanks.

Bibliography of North American Geology, 1935 and 1936. By E. M. Thom. U.S. Geological Survey Bulletin 892. Pp. 320; index, pp. 321–504. Superintendent of Documents, Washington, D.C. Price 50 cents.

This bibliography of North American geology, including palæontology, petrology and mineralogy, for the years 1935 and 1936, lists publications on the geology of North America and adjacent islands and on Panama and the Hawaiian Islands. It includes text-books and papers of general character by American authors and papers by foreign authors which have appeared in American publications.

Kodiak and Adjacent Islands, Alaska. By S. R. Capps. U.S. Geological Survey Bulletin 880-C. Pp. iv + 182; index, pp. 183–184. Pocket map. Superintendent of Documents, Washington, D.C. Price 50 cents.

An account is given of the geological structure of the Kodiak group of islands. These islands, having an area of 4900 square miles, lie on the Pacific Ocean side of the base of the Alaska Peninsula, to the north-east. The geology of the two areas is strikingly similar.

Major Texas Floods of 1936. By T. Dalrymple. U.S. Geological Survey, Water-supply Paper 816. Pp. 142; index, pp. 143–146. Superintendent of Documents, Washington, D.C. Price 25 cents.

The information in this Report includes profiles of flood-crest stages on about 884 miles of rivers, results of 40 determinations of peak discharges made at miscellaneous places, records of peak stages and discharges and of mean daily discharges during flood periods at about 40 regular river-measurement stations, hydrographs of discharge at 26 river-measurement stations, records of rainfall at about 400 places, 8 isohyetal maps showing rainfall over the entire State and 4 isohyetal maps showing rainfall in more detail over smaller areas, records of past floods at all places in the State at which authentic records were available, and other data pertinent to floods in Texas.

Records of the Geological Survey of India, Vol. 72, Part 2, 1937. Pp. 135–236. Central Book Depot, 8, Hastings Street, Calcutta. Price 5*s*. 3*d*.

Included in the papers in this volume is a report on "Petroleum Technology in Burma during 1936, with Special Reference to the production of Oil and Gas Sands," by E. J. Bradshaw. Quarterly statistics are given on the production of coal, gold and petroleum in India, January to March 1937.

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Geology.

596. Mississippian Gas Sands of Central Michigan Area. E. W. Hard. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 129–174.—Since 1926, following the development of the Saginaw oilfield, a number of important gas-fields have been discovered in the central part of the Southern Peninsula of Michigan. These fields, which produce from Mississippian rocks at depths from 800 to 1500 ft., are located in an area which includes parts of Clare, Isabella, Gratiot, Mecosta, Midland and Montcalm counties. Three parallel folds cross the area about 15 miles apart, and from these gas production is generally confined.

The problems presented are: a study of the stratigraphy and the origin of the gas sands, and the relation of gas production in the Mississippian to oil production in the Devonian, where the two areas, although not directly superimposed, are on the same general "high."

As originally described, the Marshall group of the Mississippian was separated into two divisions: the Upper Marshall or Napoleon Sandstone, and the Lower Marshall. Later, however, in Saginaw Co., it was shown that three recognizable units were present, the upper two of light-coloured sandstone, and the lower of red sandstone and shales. It was from the Napoleon Sandstone (Michigan age) that production in the Clare gas-field was thought to be obtained in 1929. Subsequent deeper drilling, however, revealed 40–50 ft. of other deposits (limestones, etc.) between the producing sand and a lower sandstone that more closely resembled the Napoleon. The intervening layers being similar to the overlying Michigan, it was thought that the gas belonged to the latter rather than to the Marshall. The term "stray sand" was therefore given to this gas-producing bed.

A close examination of all the available data from the various fields seems to show that the gas-sands are not all of the same stratigraphic horizon. Doubtless some of the sand in the lower part of the Michigan is re-worked Marshall. Although an unconformity was earlier postulated between the Michigan and Marshall, there does not appear to be any definite evidence of this in the central part of the area studied. Thus the exact contact between these formations is difficult to determine. The relation between the upper Marshall and the lower Michigan, however, suggests a deltaic or littoral deposit, the area of greatest sand deposition occurring in the central and south-eastern parts of the area. The lower part of the Michigan in the north-east appears to be an off-shore phase of the Marshall farther west.

With regard to the source of the gas, the author concludes that while most of the gas occurs in or near the top of the Marshall, it is possible that the gas used the Marshall Sands as a channel for migration. Despite the fact that certain of the probable source-beds are in contact with the upper part of this formation, it is possible that part of the gas came from greater depths, perhaps from the Coldwater shales.

A large number of structural maps and cross-sections accompany the paper.

G. S. S.

597. Sediments of Santa Monica Bay, California. F. P. Shepard and G. A. Macdonald. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 201–216.—In Santa Monica Bay, extending between Palos Verdes Hills on the south and Point Dume on the north, occurs a relatively wide continental shelf. From this shelf and from two submarine canyons cutting it a collection of about 200 sediments was made.

Both canyons (Redondo and Santa Monica) appear to have had a marked effect on the migration of the sediments along the shelf. A map is given showing the topography of the sea bottom in the Bay.

The sediments showed no appreciable outward decrease in size, coarse material occurring both near shore and at the outer margin. It would appear that the sediment is either derived locally from the rock outcrops on the sea bottom or that it was transported to its present position during a time of lower sea-level, perhaps during the glacial stages.

Mineralogically, quartz is the most abundant constituent, and is associated with felspars, including microline. Of the heavy minerals, the following predominate: glauconite, hornblende, hypersthene, titanite and ilmenite, apatite, diopside, epidote and garnet. The relative abundance of the mineral species is given in tabular form.

G. S. S.

598. Search for Oil in Tunisia. A. Roux and M. Solignac. *Ann. Off. Combust. liq.*, Sept.–Oct., 1937, 865–904.—Tunisia may be divided into six structural zones, each possessing individual tectonic and stratigraphic characteristics. (1) Firstly there is the zone of Oligocene and Eocene neo-Nummulitic clays, composed of long folds, a prolongation of the Algerian Numidic chain, running west–east, and then bending to the north or north-east. Some Trias and Cretaceous inliers are exposed. (2) Southern Tunis is a zone of south-west–north-east folds. There is a tendency for domes to be formed, most of which have a Triassic diaperic core and resemble German salt domes. Many oil indications are found in this zone. (3) Central Tunisia is composed of more neritic Cretaceous and Eocene sediments than (2), and the folding has a more northerly component. Some domes occur here, too. (4) Northern Tunisia is composed of more neritic sediments than (2) and (3) and the folds are wider spaced. (5) The Sahel zone runs north–south-east of (3) and (4). It is covered largely by young terrace deposits, but some Miocene is exposed in several domes which are common in this region. Surface indications of oil are absent, but the domes are perfectly sealed by the middle Miocene and Pontic clays, and will require wells 2000–2500 m. for exploration. (6) The extreme southern zone of Tunisia contains some enormous domes; the two largest are Chott Fedjedj (Wealden core) and Jefara (Triassic core). The doming tectonics are superposed upon Hyrcynian folding.

Surface Indications.—These are abundant, and consist of gas, light and heavy oil, bitumin and bituminous shales. These are fully described. A gilsonite vein was worked in 1913 at Djbel Diss, and similar veins occur elsewhere. The bituminous shales are mainly developed in the Santonian, where they are in abnormal contact with the Trias and contain 8–9% of oil.

Search for Oil.—This may be divided into two periods: 1894–1931 and 1931 onwards, where control was taken over by the State. The first period saw prosperity at Kef bou Debbous (no drilling), Ain Rhelal (one 800-m. well), Djeble Menzel Rhoul (no drilling), Slouguia (some shallow wells gave a little oil) and Medjiz el Bab, where one unsuccessful well, placed on the advice of a diviner, was drilled! At Cap Bon in 1925 a deep well gave oil-shows in the Cretaceous, but no production. At the beginning of the second period very little was known, and more intensive search began at Slouguia. Four wells were drilled in this area, but with no commercial success. Next the Kef Bou Debbous region was tested, near a seepage, to a depth of 1300 m. A 900-m. well at Djebel Ahmar also gave no trace of oil (1935–1936). The Djebel Kebir anticline was tested in 1935–1936, and the well had to be abandoned owing to a technical mishap. A well section is given. Numerous important gas and oil shows were met, and show promise for the area. The well reached the Campanian formation. Ain Rhelal has been explored geologically and geophysically, and is to be tested shortly. The areas at present under consideration are also discussed. It is pointed out that Tunisia offers a large number of good structures and has numerous oil indications. The relation to the Algerian and Prérif structures is discussed, but in Tunisia the Cretaceous is much better developed than in Morocco. Future drilling is intended in An Rhelal, Fedj el Adoum, Dj. Kébir, and Kef Bou Debbous, and further prospecting in the central and southern zones and Sahel, where simple and well-sealed domes exist. Seven field maps of some of the more interesting areas are included.

R. O. Y.

599. Movements of the Hanover Salt-stocks. L. Riedel. *Oel u. Kohle*, 1937, **13** (44), 1075–1079.—Many of the movements of which it is possible to determine the age took place in the Upper Cretaceous. These Upper Cretaceous movements can be divided into three groups: those taking place between the Turonian and the Upper Emscher; those in the Lower Mucronaten (Senonian), and those at the end of the Cretaceous. Other movements at other periods of the Upper Cretaceous cannot, in the light of our present knowledge, be proved. Considerably less is known of Tertiary movements, due mainly to the fact that the Tertiary has little practical interest for the oil geologist and is not cored. Tertiary movements have undoubtedly taken place, especially in the north in the region of the "Pompeckj Schwelle" and in Schleswig Holstein, but in those areas drilling activity has been small. In the south, in the Brunswick Embayment, Tertiary movement was negligible, and there has apparently been no appreciable alteration in the Cretaceous form of the salt-stocks. The evidence for pre-Upper

Cretaceous movement is also not very clear. A large number of discordances, etc., have been found around the salt masses, but it cannot be proved whether these are due to salt movement or are of a regional character.

There is insufficient evidence to connect salt uplift with the various orogenic phases. In many cases a connection seems probable, but in others the evidence is entirely lacking. Also it is still impossible to say whether or not the time of uplift for the greater number of the salt-stocks is the same. Again, when dealing with the question of episodic or continuous movement of the salt, no final answer can be given. The movement which gave rise to the salt-stocks themselves was most probably episodic, but there was also possibly a continuous movement of salt relative to its surroundings both before and after these episodic movements.

In many cases it can be shown that the uplift of the salt-stock has affected the surrounding rocks only over a very narrow zone. In this zone the strata are very considerably reduced in thickness, and this is attributed to rapid rise of the salt carrying the strata up into the zone of denudation. The existence of coarse conglomerates is evidence to this effect. The presence of a marginal trough shows that the salt rose in a tensional graben zone. S. E. C.

600. Zoning of the Tertiary at Bruchsal (Rhine Graben). B. Paul. *Oel u. Kohle*, 1937, **13** (38), 947–948.—The well DPAG-Baden 1 was located in the Buchenauer Hardt, and passed through 1490 m. of Tertiary into the Dogger. Short notes on each of the Tertiary formations and a record of the foraminifera which were found to assist in the zoning, are given. By means of the foraminifera it is shown that the Lower and Middle Oligocene have a similar development to that in Alsace and the upper Rhine potash district, whilst the Aquitanian can be correlated with the *Cerithium* and *Corbula* Beds in the Mainz basin. S. E. C.

601. Caucasian Oil Region. N. Polutoff. *Oel u. Kohle*, 1937, **13** (36), 893–900.—The Apscheron peninsula with Kabristan and the estuary of the Kura form the Baku or Aserbeidjan province. The rocks are mostly Tertiary in age. The productive horizons can be divided into three groups. The upper group, consisting of calcareous clays, sands, and sandstones, is productive in nearly all the important fields. The middle group—coarse, badly sorted sands—is productive only in Lok-Batan and Bingady. The lower group, of sands, sandy clays, and sandstones, is productive in many of the fields. A general characteristic of the folds in the S.E. Caucasus is their eastward plunge. Their strike is usually that of the main mountain range, but there are some which are bent into an arc. Details are given of the main fields in this district.

Oil shows are numerous in Georgia, but only one or two of these occurrences are of economic importance. Mirsaany is the chief field. There are twenty-seven oil horizons in the Schiraki Beds (Pliocene), but none gives high production. The N.E. limb of the anticline is thrust over the S.W.

The extensive Kuban–Black Sea district lies in the N.W. of the Caucasus, and its stratigraphical profile differs from that of the Baku area. The principal oil horizons are in the Maikop Beds (Oligocene), but oil is found also in younger beds and in older beds as far down as the Cretaceous. The most important field is Maikop, and details of this and of other fields in the district are given.

The Grosny district lies in the central part of the N. Caucasus. The development of the Oligocene and Miocene is similar to that in the Kuban district, but the Pliocene approaches more closely to the Baku type, except that the Productive Series is absent. The main oil horizons lie in the *Spaniodontella* and *Spirialis* Beds. Details are given of the Old and New Grosny fields and of others in the district.

The stratigraphy and tectonics of the Daghestan deposits along the S.W. coast of the Caspian Sea are similar to those in the Grosny district. The more important occurrences are briefly described. S. E. C.

602. Location of British Drilling Licences as at Feb. 1938. Anon. *Petrol. Times*, 26.2.38, **39**, 271.—A full-page map is given showing the concessions and positions of all wells drilled up to the present, together with geological notes. R. O. Y.

Geophysics.

603. Regional Gravity Measurements in the Upper Rhine Valley. H. Closs. *Oel u. Kohle*, 1937, **13**, 1065.—Detailed results, with maps, of a State Geophysical Survey by means of the Thyssen gravimeter. Numerous corrections were made and some anomalies were cleared up. The gravimeter results are discussed in comparison with the older pendulum survey. P. G. H.

604. Development of Geophysics in the U.S.A. R. v. Zwerger. *Oel u. Kohle*, 1937, **13** (16), 373–380.—Progress during the years 1925–1930 is summarized and then developments in the period 1930–1936 are dealt with more fully, particular attention being paid to the Gulf Coast.

The discovery of Eocene oil at Racoon Bend led to the search for deeper horizons and deeper salt structures. Dip shooting by the Reflection Seismic method was developed to aid in this search and, used in conjunction with regional gravity surveys, has proved very successful. Schlumberger surveys having shown that in the case of certain horizons it is possible to correlate between wells, the correlation method of surveying by seismic reflections was then developed. This made possible the recognition of faults, and led to the discovery of structures such as Tepetate. Technical improvements in the reflection method include better shot-hole drilling apparatus, better explosives, semi-automatic control of the amplitude of the recorded waves, replacement of oil damping by air or electro-magnetic damping, and the coupling of several geophones to one station.

Gravity measurements by the pendulum were commenced in the Gulf Coast in 1932. The Cleveland Dome was discovered by this means in 1933. Quite recently gravimeters such as the Thyssen instrument have been used for mapping regional gravity anomalies.

In other parts of the U.S.A., notably in the Mid-Continent, geophysical work is being actively pursued. The reflection seismic method is extensively used for mapping special structures. It is also used very considerably in regional work to measure the depth to the crystalline basement rocks. S. E. C.

Drilling.

605. Derrick Structures for Water Locations. I. W. Alcorn. *Petrol. Eng.*, March 1938, **9** (6), 33.—One serious problem which confronts operators in the open water in the Gulf of Mexico, off the Louisiana and Texas coast, is that of designing and building, at a reasonable cost, a derrick structure capable of withstanding the hurricanes that occasionally sweep across the region.

The engineering details and calculations involved in the design of a derrick now in use are outlined. This derrick is the first of its kind on the Gulf Coast for drilling in open water. L. V. W. C.

606. Squeeze Cementing. C. P. Parson. *Oil Wkly*, 28.2.38, **88** (12), 36.—Squeeze cementing means forcing cement slurry under pressure into or against a permeable formation or through perforations in casing and liners for the purpose of shutting off water or for reducing gas–oil ratios.

Although the method is old there have been recent developments in method, technique and cement which are producing remarkable results.

Among the developments which led up to the present form of squeezing are : better cementing technique, better equipment to handle high pressures, special cements, self-sealing fibred cements, packers, bridge plugs, etc.

These are considered in the article. L. V. W. C.

607. Industrial Diamonds and their Use in Deep Drilling. K. Hottowy. *Petrol. Z.* 6.4.38, **34** (14), 17.—A description of properties and grading of industrial stones. Those consisting of practically single crystals are only suitable for relatively soft formations. Microcrystalline stones of fine-grained structure are harder, and are chosen for drilling bits intended to drill hard formations. Diamonds withstand high

pressures, but are sensitive to mechanical blows. The stones are less damaged by drilling steadily through the hardest of rocks than through irregularly hard and soft strata. Diamond wear is about 0·44 carat per metre drilled. Methods of fixing diamonds to the drilling bit are described. P. G. H.

608. Economic Aspects of Drilling. J. E. Pogue. *Oil Wkly*, 21.3.38, **89** (2), 36.—The author analyses the normal incentives to drilling by correlating well completions with the price of crude oil, the production of crude petroleum and oil discoveries. The recent abnormal rise in the drilling rate is emphasized and attributed to the entry of new factors largely related to the manner in which proration functions. A projection is made of the drilling rate in the State of Texas to 1942, and the per-well allowable estimated both for East Texas and the rest of the State, divided into flowing and pumping units.

It is also shown how wider well spacing and other measures for retarding the drilling impetus cannot only correct this decline, but even reverse the trend. L. V. W. C.

609. Drilling Patents. S. Evans. U.S.P. 2,104,799, 11.1.38. Packing piece for tool-joints.—F. L. Scott, U.S.P. 2,104,820, 11.1.38. Three-cutter drilling bit. Two annular cutters are mounted on shafts to cut the outer portion of the hole, and the third cutter, of elongated conical shape, has its small end extending between the two annular cutters. A toothed point on the elongated cutter extends past the centre of the hole to act with the other cutters to cut the full bottom of the hole.

F. L. Scott and N. B. Berleth. U.S.P. 2,104,821, 11.1.38. Cross roller bit.

F. L. Scott. U.S.P. 2,104,822, 11.1.38. Drill cutter.

R. P. Sherman. U.S.P. 2,104,823, 11.1.38. A plurality of downwardly and inwardly inclined shafts having a cutter on each. Each cutter is approximately conical in form, but with an acutely tapered area near the base and an obtusely tapered area near the apex.

C. W. Mackay. U.S.P. 2,105,091, 11.1.38. A well-drilling apparatus comprising a stationary drilling string with means for forcing mud to the bit. A number of electric motors are arranged at the bottom of the hole to drive the drilling bit.

O. A. Brown. U.S.P. 2,106,235, 25.1.38. Releasing spear.

T. A. Creighton. U.S.P. 2,107,327, 8.2.38. A method for cementing well casings in which plastic cement is deposited in the well before the casing is run.

J. L. Kothny. U.S.P. 2,107,420, 8.2.38. Whipstock running device.

W. T. Foster. U.S.P. 2,107,475, 8.2.38. A rotary well-drilling apparatus comprising a rotary table, a torque tube of sufficient length to house the Kelly and means on the torque tube to engage the Kelly, and a polish pipe secured to the Kelly extending downwards through the torque tube and table.

T. M. Pyle. U.S.P. 2,107,547, 8.2.38. Well reamer.

A. C. Catland. U.S.P. 2,107,627, 8.2.38. Well-bit construction.

W. C. Scriven. U.S.P. 2,107,631, 8.2.38. Well cleaning system.

G. G. Herrington. U.S.P. 2,107,665, 8.2.38. A roller bit.

O. B. Trotter. U.S.P. 2,108,419, 15.2.38. Whipstock with means for moving the lower section forward about a hinged joint to increase the angle of deviation.

C. F. Moseley. U.S.P. 2,108,499, 15.2.38. Fishing tool. L. V. W. C.

Production.

610. Modern Gas-Lift Practices as Applied in Mid-Continent. R. R. Kyner. *Oil Gas J.*, 24.2.38, **36** (41), 114.—This is an extensive review of the work that has been done in recent years in respect of gas-lift. Flow valves for tubing flow are dealt with in detail, as well as the conditions to which they are particularly adapted.

L. V. W. C.

611. Gas-Lift—Modern Method for Production of Oil. S. F. Shaw. *Oil Gas J.*, 3.3.38, **36** (42), 42.—A review of gas-lift operations in various parts of the world, classifying the problems under the headings of depth, pressure, permeability of the sand and character of the fluid to be lifted. L. V. W. C.

612. Backside Crank Pumping being Greatly Extended. Anon. *Oil Gas J.*, 24.2.38, **36** (41), 89.—A prominent part is now being assumed by backside cranking in oil-well-pumping methods. Economic considerations and low daily allowables have stimulated its extensive use to heavier pumping wells.

This system of oil-well pumping offers a flexibility not realized by cycles for jack wells operating off central powers.

Balance is the major item which must be worked out, but in addition backside cranking involves the mechanics in the design and operation of rod-lines, swings, posts, etc. Larger lines are required, due to the greater loads at greater depths and to obtain the necessary flexibility of pumping cycles. It is especially important on such heavy-duty installations that correct alignment be obtained, as well as the elimination of all possible friction losses.

A backside crank assembly is a push-and-pull arrangement receiving its power from a central source, whereby loads exerted in one direction are compensated for in another. Although a wide variety of constructions exist, two-well hook-ups employ the conventional standard rig or individual unit at one well.

Limitations in the application of backside cranking are given and the balancing of the outfit is discussed. L. V. W. C.

613. Proper Lifting Equipment Selection and Installation. F. L. Swindell. *Oil Wkly*, 7.3.38, **88** (13), 54.—The problem of the selection and installation of the proper type of pumping equipment resolves itself into two principal divisions: (1) equipment capable of meeting the ultimate conditions, and (2) proper installation of that equipment.

The consideration of probable ultimate conditions involves many variables. A statement of the problem and some of the considerations are given.

Many errors which develop as a construction job progresses can be traced directly to improper planning of an installation before actual construction is begun. Planning should be considered well in advance of the artificial lift period to give ample time for the construction of the necessary plant. L. V. W. C.

614. Acidizing Core Samples to get Comparative Rating of Formations. L. C. Chamberlain, Jr. *Oil Wkly*, 28.2.38, **88** (12), 20.—Acidizing of cores enables field service to be improved by observation and comparison of the results obtained.

During a study of the acidizing of cores, the author felt that some comparatively simple means of rating samples for treatability was needed. He has, therefore, evolved an "Acidizing Index." This index is not necessarily a function of the type of treatment given, but is more dependent on the chemical and physical characteristics of the producing formation.

The index is based on a calculation which is given, and it is suggested that it is one of the best indications of the adaptability of the formation to acidizing. When the same amount of acid is used on two wells, that well which has the highest acidizing index should give the greater relative increase in production. It is a function of two factors: increase in permeability and loss in weight. Increased permeability is a direct measurement of increased rate of flow, and this increase is generally caused by removal of pore-blocking materials. This factor alone cannot be used as a measure of the treatability of a formation, but by using an index which is a function of both increase of permeability and the loss in weight, a unit is obtained which takes into account both the increase in flow obtained and the amount of the acid used.
L. V. W. C.

615. "Closed System" Makes Effective Salt-Water Disposal Plant. L. H. Towers. *Petrol. Eng.*, March 1938, **9** (6), 52.—Engineering skill and design are required in the disposal of salt water by returning it to subsurface sands.

This problem appears to have been solved by using a "closed system" which prevents air coming in contact with the salt water at any time. The salt water is

processed rapidly and economically, and the exclusion of the air has reduced corrosion to a minimum.

The plant, which is described, has a capacity of 1500 brl. per day, and this could be doubled by the addition of another reciprocating pump and engine. L. V. W. C.

616. Practical Repressuring. N. M. Wilder. *Bull. Amer. Assoc. Petrol. Geol.*, 1938, **22**, 189–200.—Three repressuring projects in the Corniferous formation of E. Kentucky are described. While certain practical difficulties are dealt with, it is not suggested that any standard rules, of application to other areas, may be drawn. The number and location of pressure wells depend largely on the spacing of the original pumping wells and on drilling costs. A close spacing of 250–300 ft. is desirable whenever possible.

Each input well is cored, and the cores are examined for permeability and oil saturation. Acid treatment is not adopted. The permeability profiles of the wells are studied and divided into zones. Quantities and pressures of the input air vary with field conditions. From 450 to 1000 cu. ft. air per foot of "pay" is usual. The pressures on different zones are varied according to their permeabilities. The average daily production of the three projects before repressuring were 7·5, 42·2, 14·6 brls./day, and on repressuring rose to 40, 107, 58·4, respectively.

Gas–oil ratios are useful as an index to efficiency, and failures are avoided by studying them. Ratios are generally less than 2000 cu. ft./brl. of oil, and when they approach this the ratio is reduced by raising the working barrel, thus increasing the back pressure or by reducing intake in the most permeable zones. R. O. Y.

617. Inexpensive Reconditioning of Oil Wells. Part 2. H. E. Winter. *Petrol. Eng.*, March 1938, **9** (6), 48.—Little progress can be made in shutting off water until its point of entry is definitely located. Before an attempt is made to locate the point of entry the perforations should be washed, and a quantity should then be produced to insure that the water will be located accurately.

A number of methods of water location are in general use. The electrical methods all recondition the hole and depend on bailing or swabbing to lower the static fluid head to allow the water to enter.

There are four general points of entry for water, and the methods and equipment for use in shutting off water will be determined by the point of entry and the facilities available.

Each of the general points of entry are dealt with in some detail. L. V. W. C.

618. Rational Operation of Petroleum Wells. D. Nicolaescu. *Monit. Petr. roum.*, 1938, **39**, 95–100.—A general survey of the accepted modern technique in the exploitation of oil wells, with particular reference to the utilization of natural gas pressures. The article is devoted primarily to technique which should be practised in Roumanian fields, where oil is usually located in varieties of sand.

The author claims that if the technique he outlines was made general, 70% or more of the crude oil in a field would be extracted, instead of the 20–25% which is normally the case. T. C. G. T.

619. Some Applications of Metering in Oilfield Operations. D. Comins. *J. Instn Petrol. Tech.*, 1938, **24**, 140–157.—An account of the special technique employed on the Iranian fields to carry out the measurement of "live" crude-oil production, together with a discussion on the comparative accuracy of routine orifice metering and of tank dipping. G. R. N.

620. Production Patents. R. Neuhaus and F. C. Smith, Jr. U.S.P. 2,104,808, 11.1.38. Flow head.

E. L. Condra. U.S.P. 2,104,942, 11.1.38. A pressure bailer comprising a casing and a tube which are telescopically joined together. A fluid passage is arranged to be closed at the top and seated against the lower end of the casing and means for lifting the conduit from its seat.

S. A. Guiberson. U.S.P. 2,106,392, 25.1.38. Anchoring device for well strings.

F. J. Spang. U.S.P. 2,106,859, 1.2.38. Hook wall-packer.

W. K. Edwards. U.S.P. 2,106,996, 1.2.38. Bottom tubing plug for oil wells.

W. E. Lang. U.S.P. 2,107,006, 1.2.38. An apparatus for treating depleted oil sands comprising a pressure packer having a chamber connected to the well tubing and passages for conducting fluid under pressure between the chamber and the exterior of the packer. Means adapted to releasably press and seal the packer against the wall of the well to prevent flow of fluid under pressure lengthwise along the exterior of the packer.

W. E. Lang. U.S.P. 2,107,007, 1.2.38. A method of increasing recovery from oil sands in which pressure fluid may be injected under pressure into one or more strata of relatively low permeability without injection into strata of relatively high permeability.

C. E. Van Stone. U.S.P. 2,107,457, 8.2.38. A well-testing tool.

A. R. Maier. U.S.P. 2,107,488, 8.2.38. A beam hanger for well pumps.

C. W. Vogt and G. A. Humason. U.S.P. 2,107,655, 8.2.38. A well-testing device.

C. B. Margrave. U.S.P. 2,108,172, 15.2.38. A casing perforator.

T. E. Stockdale. U.S.P. 2,108,784, 15.2.38. Large-capacity storage tank for storing a body of fusible, normally solid hydrocarbon material such as wax. A tubular heater is placed near the bottom of the tank to produce liquefaction of the material near to a draw-off line for causing it to flow through the line. A pressure relief passage-way through the body of the material is arranged between the top and the portion adjacent to the tubular heater. The pressure is thus relieved prior to the normal penetration of the heat through the material to the upper portion. An additional heating tube is placed in the conduit through which the material flows.

L. V. W. C.

Transport and Storage.

621. Theory of the Corrosion–Time Relationship for Underground Pipes. N. L. Hoff. *Petrol. Engr*, March 1938, **9** (6), 38.—The theories of Pilling, Bedworth and Evans on the parabolic nature of the corrosion–time relationship are criticized on the score of not being valid at the lower limit, *i.e.*, at zero time and pitting, when the rate of corrosion should become infinite. Also, although offering a reasonable explanation of some types of corrosion, it is doubtful if they explain the corrosion of ferrous metals buried in the soil. Brennan's hypothesis of the inverse relationship of the rate of corrosion to time, including an arbitrary constant for the corrosivity of the soil, appears to apply to the initial stages of corrosion in soil, but indicates too long a life for small pipes under the mildest conditions. Passano considers corrosion to be linear in the initial stages and later parabolic.

A study of 4000 pit-depth measurements on bare steel and wrought-iron pipes of various ages in Southern California has disclosed the inadequacy of the above theories, and has suggested that the corrosion–time relationship is actually logarithmic in character. It is assumed that the rate of corrosion is directly proportional to the depth of the pit and inversely proportional to the time. This is based on a consideration of the forces tending to accelerate corrosion and those tending to decelerate corrosion. Of the former the electrolytic action between the metal and its products of corrosion is the most important, injuries to the metal, the presence of mill scale, stresses, stray currents and dissimilar metals in contact also playing a part. It is considered justifiable to assume that in the early stages of corrosion the corrosion rate is directly proportional to the amount of oxides present. As this is generally a measure of the depth of the pit, the latter may be taken as proportional to the corrosion rate.

The factors tending to decelerate corrosion—viz. formation of inhibitive scales of soil or corrosion products, polarization by hydrogen film, decrease in the supply of oxygen and depletion of the reactants, leaching out of soluble salts and the change of soluble salts to insoluble secondary compounds—are all considered to be inversely related to time.

A statistical survey of Brennan's semi-log formula and the author's log-log formula

as applied to the pipes examined indicates a practically identical serviceability, but if pipes of longer than 10–15 years' service are considered, the semi-log formula gives an excessive life for the pipe, owing to the rapid flattening of the curve, whereas the log-log curve gives a more reasonable age. In this connection difficulties are experienced owing to the absence of reliable pit measurements on pipes over 15–20 years old.

C. L. G.

622. Improved Operation of Wind-Chargers for Cathodic Protection of Pipe-Lines. D. Harrell. *Petrol. Engr*, March 1938, **9** (6), 76.—The value of a vacuum-tube voltmeter for indicating the extent by which the voltage of a cathodic protection unit has fallen after cessation of the generator, due to wind stoppage, is pointed out. Tests on a line protected for a total period of 46·38% of a month showed that the negative decline curve depended not only on the length of time during which no charge is placed on the pipe, but also on the length of time that the line is charged in successive intervals. The charge on the pipe was found to be below the protective potential of — 0·24 volt for 62 hrs. during the first ten-day period, and was also over-charged to a greater extent than it was under-charged. In order to conserve the power available, on windy days a battery was used, charged by the wind charger and fed into the pipe. There was frequently, however, insufficient current to supply both battery and pipe. It was therefore decided to instal a second wind-charger which would charge the battery while the first one was supplying current to the pipe. This has been extremely satisfactory in operation.

C. L. G.

623. Pipe Coatings. C. Fitzgerald and M. G. Johnson. *Industr. Engng Chem.*, 1938, **30** (3), 294.—A promising method of coating pipe is described, utilizing spiral wraps of black stock celluloid over an asphalt coating. Excellent protection has been obtained in highly corrosive soils, and application is easy even around such obstacles as collars, girth welds and edges of half soles, etc. The use of pure rubber in the form of rolls in a similar manner has also been investigated, and may prove equally successful.

H. C. R.

624. Measuring, Sampling and Testing Oil under A.P.I. Code. O. D. Stallard, Jr. *Oil Wkly*, 14.3.38, **89** (1), 20.—A comprehensive review of measuring, sampling and testing crude oil. A complete set of instruments comprises a miniature field laboratory, such equipment as steel gauge, oil thief, bottle thief, cup-case thermometer, hydrometer, etc., being furnished.

The current operations of a modern field gauger and the equipment necessary to perform his tasks are described.

L. V. W. C.

625. Improvements Recommended for Installation of Field Tanks. O. D. Stallard, Jr. *Oil Wkly*, 7.3.38, **88** (13), 17.—Efforts are being made to assist oil producers in keeping their field tanks clean and attention is being given to the placing of flanges and the hanging of hatches.

In the past little thought has been given to the placing of hatches, flow lines, test lines and treater lines. More attention should be given to this matter if tank tops are to be kept clean. Hatches placed in the wrong position cause spilling of oil during gauging.

The author directs attention to improvements that would eliminate a number of disadvantages and unnecessary work in the field.

L. V. W. C.

626. Modern Methods of Cleansing Fuel and Oil Containers. A. Besag. *Ole, Fette, Wachse*, 1938 (2), 10.—Description of an improved appliance for cleaning used drums by spraying internally with light petroleum distillate. The spray nozzle is arranged to rise automatically into the bung-hole. A special jet for drums with tap-holes placed asymmetrically at the lower part is described. To remove viscous oil residues a special equipment using hot water, followed by alkali washing, is necessary.

P. G. H.

See also Abstract No. 619.

Crude Petroleum.

627. Patents on Crude Petroleum. W. E. Elliott. U.S.P. 2,107,473, 8.2.38. Treatment of emulsified hydrocarbons—*e.g.* crude oil or fuel oil, with naphthalene containing a small quantity of nitrobenzol, sod. carbonate, carbon tetrachloride or iron sulphate.

M. De Groote, B. Keiser, L. L. Faure and A. F. Wirtel. U.S.P. 2,108,960–2,108,961, 22.2.38. Breaking water-in-oil emulsions using as demulsifying agent a *cyclo*hexylamine salt of a polyalkylated naphthene sulphonic acid containing at least one butyl and one amyl group. W. S. E. C.

Gas.

628. Necessity for the Laying of Natural Gas Lines to Bucharest. I. R. Arapu. *Monit. Petr. roum.*, 1938, **39**, 275–276.—Bucharest offers a potential market for about 430,000,000 cu. metres of natural gas per year. Its advent as a fuel would displace wood and fuel oil. An appeal is made to form an association to forward the scheme. T. C. G. T.

629. Patents on Gas. Lodge-Cottrell Ltd., and L. Lodge. E.P. 479,164, 1.2.38. Improved apparatus for the electrical precipitation of suspended particles from gases.

H. Dreyfus. E.P. 479,438, 4.2.38. Production of acetylene by subjecting normally liquid hydrocarbons to thermal decomposition in two successive stages—the first at 600–1000° C. and the second above 1000° C.

R. F. Bacon. E.P. 479,630, 9.2.38. Recovery of SO_2 from gases by means of an aqueous solution of an alkali metal or ammonium salt of a weak acid—*e.g.* benzoic, fumaric, phthalic, etc.—which is capable of reacting with sulphurous acid to form a sulphite. The So_2 is then expelled by heating the sulphite. W. S. E. C.

Cracking.

630. Patent on Cracking. G. W. Johnson. E.P. 480,442, 21.2.38. Cracking of the hydrocarbon fraction boiling >250° C. of synthetic hydrocarbons obtained from CO and H_2 in which the hydrocarbons are refined prior to cracking either by hydrogenation or by means of selective solvents. W. S. E. C.

Hydrogenation.

631. Patents on Hydrogenation. P. Marécaux. E.P. 479,428, 31.1.38. Catalytic hydrogenation of hydrocarbons containing sulphur into hydrocarbons of lower m. pt. and b. pt.

B. Malishev. E.P. 480,011, 14.2.38. Hydrogenation and dehydrogenation of aromatic into naphthene hydrocarbons at 300° C. and under 100 atm. pressure, using P_2O_5 only as catalyst.

Gewerkschaft Mathias Stinnes. E.P. 480,644, 25.2.38. Catalytic hydrogenation of coal.

International Hydrogenation Patents Co. Ltd., and I.G. Farbenindustrie A.-G. E.P. 480,739, 28.2.38. Production and recovery of molybdenum from liquids containing molybdenum anions by contacting the liquids for some time with $PbSO_4$ and then mechanically separating the solids from the liquid.

M. H. Gwynn. U.S.P. 2,106,735, 1.2.38. Catalytic hydrogenation of crude benzene derivatives—*e.g.* polymethyl benzenes mixed with crude unsaturated compounds using a nickel catalyst.

C. Ellis. U.S.P. 2,106,973, 1.2.38. Hydrogenation of coals with high oxygen content—*e.g.* lignite—to give liquid products. W. S. E. C.

Polymerization.

632. Patents on Polymerization. N.V. de Bataafsche Petroleum Mij. E.P. 479,632, 9.2.38. Polymerization in the liquid phase of olefine mixtures—*e.g.* benzines obtained by vapour-phase cracking of paraffin wax to produce lubricating oil. Water is first added to the mixture, and aluminium, zinc, or ferric chloride is applied as catalyst.

N.V. de Bataafsche Petroleum Mij. E.P. 479,657, 9.2.38. Catalytic polymerization using a phosphoric acid catalyst, of tertiary and non-tertiary olefines containing four or five carbon atoms in the molecule.

H. I. Waterman and Imperial Chemical Industries Ltd. E.P. 480,677, 22.2.38. Polymerization of drying oils by heating them in the presence of dry SO_2.

A. Carpmael. E.P. 480,756, 28.2.38. Manufacture of condensation and polymerization products from olefines using the acid sodium salt of phosphotungstic acid as catalyst. W. S. E. C.

Refining and Refinery Plant.

633. Application of Automatic Control to Refinery Process Operations. S. W. Adey. *J. Instn Petrol. Tech.*, 1938, **24**, 125–139.—A paper giving a description of the more important types of process control instruments and their theoretical basis; selection of methods of control, installation, service co-operation, economic aspects and service repairs are adequately discussed. G. R. N.

634. Patent Literature in Refining Technology. VIII. Synthetic Lubricants. J. H. Byers. *Nat. Petrol. News*, 9.2.38, **30** (6), R. 42, 23.2.38, **30** (8), R. 67.—Fifty-eight patent specifications dealing with some aspect of the synthesis of lubricants are reviewed. A great diversity of raw material, from hydrogen and carbon monoxide to coal and coal-distillation products, is mentioned. Gaseous paraffinic and olefinic hydrocarbons are polymerized to yield oily bodies of high molecular weight. The nature of the catalysts is almost as diverse, and electric discharge and ultra-violet light are also mentioned as essential relevant features of a number of processes. Petroleum and petroleum products are the commonest source of raw material. Many patents have as their aim the improvement of viscosity/temperature and coking characteristics. One patent claims to produce, by the polymerization of cracked hydrocarbon waxes, a synthetic lubricant with better viscosity/temperature characteristics than those of Pennsylvanian oils. H. G.

Chemistry and Physics of Petroleum.

635. Compressibility of Liquid Naphthalene. F. R. Russel and H. C. Hottel. *Industr. Engng Chem.*, 1938, **30** (3), 243.—Curves are given showing the relationship between the specific gravity at constant temperature and pressure, and the specific gravity at constant pressure and temperature, for naphthalene over the temperature range 200–880° F. and pressure range 0–6000 lb. per sq. in. From these data the compressibility factors for suitable pressure ranges at a series of different temperatures have been calculated. Full experimental details of the technique employed in obtaining the foregoing data are provided. J. W. H.

636. Electrical and Chemical Studies of Oil Oxidation. J. C. Balsbaugh, R. G. Larsen and J. L. Oneley. *Industr. Engng Chem.*, 1938, **30** (3), 287.—The effect of solvent extraction on the oxidation and electrical characteristics of a series of oils is studied. It is concluded that the correlation of physical, chemical and electrical properties of an oil is greatly facilitated by an examination of raffinates and extracts obtained from it. The advantages of the conjugate Schering bridge for the determination of power factor are discussed, and designs are given for (i) a stainless steel cell having a volume of 2 c.c. and a capacitance of 6·5 $\mu\mu$f, and (ii) a new type of quartz cell holding 10 c.c. of oil. J. W. H.

Analysis and Testing.

637. Tests with the Thoma Oil Tester. E. H. Kadmer. *Oel u. Kohle*, 1938, **14**, 147.—In the Thoma machine the friction between two rollers (axes at right angles) under fixed conditions of lubrication is measured by torsion balance (Abstr. No. 1053, *1935*). The temperature is so chosen that the oil is brought to viscosity = 80 cps. or 40 cps.

The frictions at different loads are tabulated for 41 oils of different sp. gr. and varying chemical constitution, the results being given together with refractive index, aniline point, viscosity pole height and C ring : C chain ratios. The mean friction (obtained from values at different loads) increased proportionally with the sp. gr., viscosity pole height, and percentage C rings. Oils rich in paraffin chain molecules were more efficient in reducing friction than were those rich in aromatics. There was an undoubted relationship between friction and certain physical properties (density, n_D, aniline point, and C ring : C chain ratio). P. G. H.

638. Detection of Benzole Vapour in Storage Tanks, etc. K. Gemeinhardt. *Petrol. Z.*, 13.4.38, **34** (15), *Motorenbetrieb.* p. 2.—This method, carried out with the Dräger–Schröter apparatus, depends on the formation of a brown colour when benzole (toluene or xylene) reacts with a mixture of formalin and concentrated sulphuric acid. A definite volume of the air under test is drawn by means of a hand pump through active carbon, which adsorbs the benzole. The carbon is extracted with alcohol under standard conditions. Formalin–H_2SO_4 is carefully added to the extract, and the intensity of the colour at the interface of the layers is compared with known standards. P. G. H.

639. Confining Liquids for Gas Analysis. K. A. Kobe and F. H. Kenton. *Industr. Engng Chem. Anal.*, 1938, **10** (2), 76.—Continuing their work on the use of an acidified solution of sodium sulphate as the most practical confining liquid for use in technical gas analysis equipment, the authors have determined the solubilities and Bunsen coefficients of some of the commoner gases and gaseous mixtures in this solution at 25° C. and a partial pressure of one atmosphere. The gases included methane, ethane and ethylene. G. R. N.

640. New Capillary Type Viscometer. P. E. Raaschon. *Industr. Engng Chem. Anal.*, 1938, **10** (1), 35.—The viscometer is of the U tube type, with a single bulb and capillary tube forming the narrow limb. A thermometer suspended in the wide limb by means of a cork serves for level adjustment. A comprehensive series of tests in several Danish laboratories have shown that it fulfils the requirements for standard apparatus. Features of this viscometer are : (i) wide range 1·5–100 centistokes by one method and 100–5000 centistokes by a second method ; (ii) errors due to surface tension effects are minimized ; (iii) zero adjustment of the apparatus can be made with great accuracy and (iv) the efflux quantity is constant. G. R. N.

641. Smoke Tendency Lamp. J. B. Terry and E. Field. *Industr. Engng Chem. Anal.*, 1938, **10** (1), 33.—As a result of their experience on the measurement of the smoke tendency of various grades of kerosine using the improved factor lamp, the authors have re-designed this lamp to embody such features as portability and compactness, and to make a precision instrument capable of at least the same degree of reproducibility. The new instrument is described in detail, and the results show that duplicate samples should agree within 2 mm. G. R. N.

Motor Fuels.

642. Patents on Motor Fuels. W. W. Triggs. E.P. 479,441, 4.2.38. Refining crude benzole, benzines and synthetic cracked benzines by means of porous substances—*e.g.* bleaching earth, pumice, charcoal, silica gel, kieselguhr—impregnated with cresol.

N.V. de Bataafsche Petroleum Mij. E.P. 479,827, 11.2.38. Preparation of liquid saturated hydrocarbons by mixing *iso*butane and one or more alkenes containing three or four carbon atoms in the molecule with H_2SO_4 (90–100% concentration) between − 10° and + 30° C.

E. Fischer. E.P. 479,931, 9.2.38. Conversion of CO and H_2 or gases containing them at 1500 atm. or higher pressure to produce synthetic hydrocarbons. The temperature is kept below that necessary for the reaction to take place until the final pressure stage has been reached, it is then allowed to rise to 800–1000° C.

N.V. de Bataafsche Petroleum Mij. E.P. 479,940, 15.2.38. Production of motor spirit by heating a mixture of *iso*butene and excess of one or more secondary olefines with H_2SO_4 (64–72% concentration) at 60° C. at least to effect interpolymerization; the octene fraction formed is then hydrogenated using a nickel catalyst at 150–300° C.

E. V. Bereslavsky. E.P. 479,969, 15.2.38. Fuels for internal-combustion engines consisting of a cracked hydrocarbon distillate and 10% by volume of a mixture of primary, secondary and tertiary amyl nitrates.

J. M. Wadsworth. U.S.P. 2,107,354, 8.2.38. Apparatus for decolorizing or desulphurizing hydrocarbons using a catalytic material such as fuller's earth.

H. R. Rowland and E. J. Smith. U.S.P. 2,107,713, 8.2.38. Removal of sulphur and gum-forming constituents from cracked spirit by adding free chlorine and leaving the mixture to react for 12–24 hrs. The treated oil is then distilled in the presence of granulated zinc.

F. E. Kimball. U.S.P. 2,108,438, 15.2.38. Refining hydrocarbon vapours at 355–487° F. by passing them beneath the surface of a fused mixture of 3 : 1 parts of zinc and ammonium chlorides respectively.

H. S. Montgomery. U.S.P. 2,108,690, 15.2.38. Vapour-phase refining of petroleum hydrocarbons using adsorbents.

E. G. Ragatz. U.S.P. 2,109,201, 22.2.38. Apparatus for stabilizing gasoline.

W. S. E. C.

Gas, Diesel and Fuel Oils.

643. Calibration of I.P.T. Diesel Reference Fuels. Anon. *J. Instn Petrol. Tech.*, 1938, **24**, 170–179.—An account of the results obtained by three participating laboratories on the calibration of the I.P.T. Diesel Reference Fuels in terms of cetane and cetene numbers, together with the details of the tentative method of determining ignition quality of diesel fuels (F.O. 39 (T)).

G. R. N.

644. Satisfactory Tractor Fuel Defined by Agriculturalists. Anon. *Nat. Petrol. News*, 23.2.38, **30** (8), R. 85.—Minimum specifications for a " generally satisfactory distillate fuel intended for use in the conventional low-compression tractor of to-day " by E. I. Barger of the Kansas State College as follows :

Gravity (min.)	38° A.P.I.
I.B.P. (max.)	360° F.
10%	390° F.
30%	420° F.
50%	435° F.
70%	450° F.
90%	480° F.
95%	515° F.
End-point	540° F.
Octane rating (min.)	30
Sulphur content (max.)	0·2%

H. G.

645. Revised Fuel Oil Specifications. Anon. *Nat. Petrol. News*, 2.3.38, **30** (9), 24.—Commercial Standard C.S. 12/35 as revised by Technical Committee E of A.S.T.M. Committee D_2.

Grade.	Flash Point, ° F.		Pour Point, ° F.	Water and Sediment, %	Carbon Residue, % Max.
	Min.	Max.	Max.	Max.	
No. 1. Fuel Oil—a distillate oil for use in burners requiring a volatile fuel.	100 or legal	165	15	Trace	0·05 on 10% bottoms
No. 2. Fuel Oil—a distillate oil for use in burners requiring a moderately volatile fuel.	110 or legal	190	15	0·05	0·25 on 10% bottoms
No. 3. Fuel Oil—a distillate oil for use in burners requiring a low-viscosity fuel.	110 or legal	230	20	0·10	0·15 straight
No. 5. Fuel Oil—an oil for use in burners requiring a medium viscosity fuel.	130 or legal	—	—	1·00	—
No. 6. Fuel Oil—an oil for use in burners equipped with preheaters requiring high-viscosity fuel.	150	—	—	2·00	—

Grade.	Ash, % Max.	Distillation Temperatures, ° F.				Viscosity Seconds.			
		10% Point, Max.	90% Point.		End-point.		Saybolt Universal at 100° F.		Saybolt Furol at 122° F.	
			Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
No. 1. Fuel Oil—a distillate oil for use in burners requiring a volatile fuel	—	410	—	—	560	—	—	—	—	—
No. 2. Fuel Oil—a distillate oil for use in burners requiring a moderately volatile fuel	—	440	600	—	—	—	—	—	—	—
No. 3. Fuel Oil—a distillate oil for use in burners requiring a low-viscosity fuel	—	—	675	600	—	—	55	—	—	—
No. 5. Fuel Oil—an oil for use in burners requiring a medium-viscosity fuel	0·10	—	—	—	—	—	—	60	40	—
No. 6. Fuel Oil—an oil for use in burners equipped with preheaters requiring high-viscosity fuel	—	—	—	—	—	—	—	—	300	45

H. G.

646. Patent on Kerosene. M. T. Kendall. U.S.P. 2,109,446, 22.2.38.—Production of kerosene from crude mineral oil by separating two fractions by non-cracking distillation—one distilling between 360° and 435° and a heavier fraction distilling between 435° and 490° F. Each fraction is refined separately with H_2SO_4, and the acid-treated distillates are blended and not redistilled. W. S. E. C.

Lubricants and Lubrication.

647. Examination of the Behaviour of Lubricating Oils at Low Temperatures. S. Eck. *Oel u. Kohle*, 1937, **13**, 853–855.—The resistance of lubricating oils to the cold is of great importance not only for motors, but also for instruments exposed to low temperatures.

At the temperature of separation of the component with the highest melting point, the oil loses the ability to flow under its own weight. This temperature is known as the pour point, and the phenomenon is due to the formation of a wax structure in the oil.

The pour point does not always indicate the behaviour of the oil in use, for in the starting up of an engine, oils with high pour points may offer less resistance than oils apparently more fluid.

A solidified oil behaves as a plastic material, and will not flow until its yield value is exceeded. However, when this occurs, the wax structure is ruptured and the resistance to flow of the resulting mush falls considerably.

Experiments were carried out in which an oil at low temperatures was forced through a capillary under various pressures, the results being expressed as curves.

It would appear that the plasticity of an oil is not entirely dependent on the temperature, and that the resistance to flow of the plastic material gives no information as to the viscous resistance after the breakdown of the structure. It is also well known that the resistance to flow of an oil below its pour point cannot be obtained by extrapolating the viscosity curve determined at higher temperatures.

Viscous flow at low temperatures can be measured in various ways, but all methods suffer from the defect that the results depend to a large extent on the conditions of the test. It is recognized that some method is required to measure both the plastic and viscous flow of an oil in relation to the temperature. D. L. S.

648. Ageing of Lubricating Oils in Relation to their Sulphur Content. W. Kley and R. Gottschalk. *Oel u. Kohle*, 1938, **14**, 220.—The test used as basis for this work consisted in passing O_3 through the oil at 150° C. for 9 hrs., preferably in presence of copper. Ageing was gauged by increase in acid value, coke residue at 500° C., and by percentage sludge. The latter was determined by diluting with petroleum spirit and settling for 24 hrs. in a graduated cylinder. One oil, deemed satisfactory according to this test, gave unexpectedly high sludge when used in an engine driven by generator gas. The S content of the aged oil was high, and it was found that the increase in S was derived from the gas itself. Independent tests showed that the ease with which S was acquired increased with the original S content of the oil.

The superior ageing qualities of lubricating oils of low S content were demonstrated by comparative runs in engines worked by sulphurous fuels (generator gas and sulphurous diesel fuels were used). P. G. H.

649. Ageing of Motor Oils. Seufert. *Oel u. Kohle*, 1938, **14**, 239.—A number of motor oils were tested by the method described elsewhere by Noack. After oxidation by air at 250° C. for 1 hr. the oil was diluted with normal benzine; the actual oxidation products were removed by active earth, from which they could be extracted (by $CHCl_3$ or 1 : 1 alcohol/benzole) and weighed. The products were resinous or asphaltic, or a mixture of both types. Since new oils may contain constituents removable in this way, the earth treatment should be applied also before oxidation as a control test.

The yield of oxidation products increased with the time interval between the end of oxidation and the earth treatment. This is thought to be due to the formation of intermediate oxidation products which slowly pass into resins, etc., by contact with air. P. G. H.

650. Steam Locomotive Development. Anon. *Fuel Econ.*, 1938, **14** (148), 29–30.—The trends of modern design are outlined. According to the American Railroad Association, the general development is towards increased steam temperatures, increased boiler pressures and better cylinder performance. Steam temperatures are already at the maximum possible with present available lubricants. The outstanding need is the provision of a cylinder oil adequate for 250–300 lb. pressure, 90 m.p.h. speeds, 1800–2000 ft.-per-min. piston speed, and 725–750° F. temperature. The oil, they indicate, will require heavier body and higher viscosity, flash and fusing points than at present used.

As regards cylinder performance, poppet valves seem to offer prospect of simplifying lubrication problems.

Fuel consumption has shown a very great improvement in recent years. Engines drawing trains weighing up to 600 tons are now running at a fuel consumption of less than 40 lb. of coal per mile. T. C. G. T.

651. Patents on Lubricating Oil. Texaco Development Co. E.P. 479,624, 9.2.38. Method of recovering solvent from slack wax separated in solvent dewaxing processes.

H. D. Elkington. E.P. 479,916, 14.2.38. Solvent extraction of lubricating oil using furfural, nitrobenzene, etc.

R. Pokorny and E. K. Mauler. E.P. 480,676, 22.2.38. Apparatus for the continuous refining of lubricating or tar oils or for regenerating used lubricating oils.

British Thomson-Houston Co., Ltd. E.P. 481,154, 7.3.38. Lubricant comprising hydrocarbon oil and 0·1–2% by wt. of benzaldehyde, salicylic aldehyde or benzoic acid.

L. B. Smith, S. R. Funsten and H. W. Field. U.S.P. 2,106,767, 1.2.38. Preparation of fluorescent products from coal-tar residue.

M. Pier and A. Eisenhut. U.S.P. 2,106,960, 1.2.38. Production of lubricating oil by subjecting a crude high-molecular paraffin-wax condensation product to extraction with propane above 25° C. and extracting the undissolved portion with a phenol–nitrobenzene mixture at 50° C.

A. A. Wells. U.S.P. 2,106,964, 1.2.38. Centrifugal dewaxing of lubricating oils.

G. H. B. Davis. U.S.P. 2,106,969, 1.2.38. Dewaxing of hydrocarbon oils by diluting and adding a small quantity of wax tailings, chilling and separating the wax.

J. McA. Harris, Jr., and N. F. Black. U.S.P. 2,106,976, 1.2.38. Neutralizing acid-treated oils having the initial b. pt. above the vapour temperature of ammonium sulphate, by blowing the oils with a non-oxidizing gas containing ammonia.

H. van der Waerden. U.S.P. 2,107,064, 1.2.38. Dewaxing hydrocarbon oils using acetone and tetrahydronaphthalene.

C. E. Adams, F. W. Sullivan, Jr., and J. A. Anderson. U.S.P. 2,107,137, 1.2.38. Dewaxing of hydrocarbon oils using as diluent methyl ethyl ketone and *iso*propyl ether as miscibility agent.

W. E. Kuhn and L. C. Kemp, Jr. U.S.P. 2,107,156, 1.2.38. Vacuum distillation of topped crude to produce lubricating oil and asphalt.

S. W. Ferris. U.S.P. 2,107,291, 8.2.38. Production of paraffinic lubricating oil from a mixed base crude by distilling the crude and bringing a portion of the distillate into contact with nitrobenzene containing pyrocatechin.

B. W. Story and V. A. Kalichevsky. U.S.P. 2,107,429, 8.2.38. Refining of lubricating oils using aniline and 6% of benzol at 60–150° F.

H. Suida, H. Pöll and A. Nowak. U.S.P. 2,107, 807, 8.2.38. Solvent extraction of lubricating oil using as solvent a mixture of 70–90 parts of crude cresol and 30–10 parts of nitrobenzene. W. S. E. C.

(*See also Abstracts Nos.* 634 and 637.)

Asphalt and Bitumen.

652. Characterization of Petroleum Residues. H. Kamptner and E. Lutzenberger. *Oel u. Kohle*, 1938, **14**, 27, 51.—These articles are introductory to the authors' main subject—characterization of bitumens by the properties of their constituents, obtained by the use of selective solvents. Current methods, dependent on temperature-susceptibility are described; the graphical method suggested by Hoepfner–Metzger for correlating the various conventional tests, and the conception of Penetration Index (Pfeiffer–van Doormaal) are discussed at some length.

Absolute viscosity measurements (Hoppler) were made on fifteen bitumens of similar m. pt. over the temperature range dropping point–210° F., and all samples complied with the Walther law for liquids. Grading by means of viscosity/temperature relationships did not place the samples in the same order as the standard DIN 1925 system of classification.

The hard asphalt content was found to influence the viscosity at the Ubbelohde dropping point in the case of residues of the same origin, but had no effect when residues of different origin, but of same m. pt., were concerned. P. G. H.

(*See also Abstract No.* 563, 1938.)

Special Products.

653. Chemical Utilization of Gaseous Hydrocarbons. Part I. Chemicals from Refinery Gases. B. Kwal. *Petrol. Engr*, March 1938, **9** (6), 57.—A survey is presented of the literature relating to the processes developed for the production of chemicals from cracked gases. Reference is made to a variety of methods for the concentration of

individual alkenes and to their reactions with sulphuric acid, to the production of ethyl alcohol from ethylene, *iso*propyl alcohol and *iso*propyl ether from propylene, *tert.*-butyl alcohol from *iso*butene, butadiene from the butenes and *tert.*-amyl alcohols from pentenes. The use of the different chemicals, either as such or as basic materials for the manufacture of other products, is discussed. C. L. G.

654. Solubility of Natural Resins in Solvents and Waxes. C. C. Mantel and R. W. Allen. *Industr. Engng Chem.*, 1938, **30** (3), 262.—The solubilities of the commercially important natural resins in a wide range of solvents have been examined, and the results are shown in the form of a table giving the types of solvent in which the resins are soluble, partly soluble and insoluble. The combining temperatures and the resulting m. pts. of the more important resins in common vegetable and mineral waxes are given. J. W. H.

655. Patents on Special Products. D. W. F. Hardie, C. F. Ockrent and I.C.I. Ltd. E.P. 479,195, 1.2.38. Manufacture of derivatives of paraffin wax by treating chlorinated paraffin wax with an alcoholic solution of KOH at high pressures to produce unsaturated derivatives of paraffin wax—and chlorinating these at high temperatures.

I.G. Farbenindustrie A.-G. and G. W. Johnson. E.P. 479,477, 7.2.38. Manufacture of polymerization products of acetylene.

Standard Oil Development Co. E.P. 480,435, 21.2.38. Preparation of synthetic resins from hydroformed naphthas by condensing them with olefines, diolefines, acetylene or ethylene dichloride.

Phillips Petroleum Co. E.P. 480,777, 24.2.38. Production of synthetic resins from SO_2 and olefine mixtures containing tertiary olefines.

Metallgesellschaft. E.P. 480,932, 2.3.38. Recovery of cadmium from zinc dust containing cadmium. W. S. E. C.

Detonation and Engines.

656. Ignition Systems for Internal-Combustion Engines. C. C. Keane. *Petrol. Engr*, March 1938, **9** (6), 41.—A discussion is presented of the principles underlying the functioning of the component parts of the different types of ignition systems used for internal-combustion engines. The causes of failure, method of detection and remedial measures are dealt with. C. L. G.

657. Turbulence in Internal-Combustion Engines. W. T. David. *Engineer*, 31.12.37, **164** (4277), 733.—To illustrate the effect of cylinder turbulence on the rate of heat loss during the explosion–expansion stroke in high-speed petrol engines, the author describes the results of experiments made in connection with the explosion in a cylindrical vessel, of various mixtures of carbon monoxide, hydrogen and air, with different degrees of fan-produced turbulence.

Comparison of the rates of fall of pressure during cooling indicates that with a slow-burning mixture the turbulence produced by the fan greatly increases the rate of heat loss after explosion, but has no effect in the early stages of cooling when a very fast-burning mixture is used.

Following the consideration and the illustration of the manner in which turbulence may be set up during combustion of inflammable mixtures in various shapes of vessels, the influence of artificially-produced turbulence on flame propagation is examined. It is shown that turbulence fails to have any effect on the initial stages of burning after ignition, either in closed-vessel explosions or in an engine, but that it speeds up greatly the subsequent stages of burning. E. F. C.

658. High Supercharging in a C.I. Engine. C. W. R. Smith. *Engineer*, 4.3.38, **165** (4286), 239; 11.3.38, **165** (4287), 281.—The investigation deals with the general behaviour of a single-cylinder, single-sleeve valve engine designed specifically for high-pressure duty and operating on the compression-ignition cycle at a low compression

ratio under highly supercharged conditions. Intake pressures up to 4 atm. absolute were used in the experiments.

The tests, which were divided into three main series, covered the effects of: (*a*) intake pressure at a given intake temperature on swirl speed, power output, fuel consumption and heat losses; (*b*) intake temperature with a given intake pressure on power output and fuel consumption.

It was found that the swirl rate at atmospheric temperature increased with intake pressure, and that the indicated power output in each series rose with increase of intake pressure over the range explored. At the upper limit, however, it was considered that the rate of injection was insufficient to maintain the output gain. In the series I experiments, conducted at 6·8 : 1 compression ratio, with the maximum combustion pressure maintained constant at twice the compression pressure by adjustment of the injection timing, the indicated fuel consumption decreased rapidly with increase of intake pressure up to 2·5 atm. absolute, and tended to rise above 3·0 atm. In series II and III tests conducted at 6·8 and 10·0 : 1 compression ratios respectively with a constant maximum pressure of 1200 lb./sq. in., the indicated fuel consumption rose with increase in intake pressure at constant intake temperature; the load range over which the engine would run satisfactorily, however, increased with the intake pressure. In all three series of tests the delay angle rapidly decreased with intake pressure up to 2·5 atm. absolute, and subsequently flattened off. From the last series of experiments it was found that the heat to the cooling water fell rapidly with increase of intake pressure when expressed as a percentage of the B.H.P., although reckoned in terms of B.H.P. the gross heat losses tended to increase; the increased swirl rate was considered to be a contributory cause of this effect. In all the series of tests with constant air intake pressure the power output fell off with increase of intake temperature, following empirical inverse square root law which the petrol engine usually obeys. Raising the air intake temperature, however, appeared to improve the combustion judged by exhaust smoke tests, but it had no significant effect on fuel consumption.

E. F. C.

659. Diesel Influence on Road Transport Costs. Past Achievements, Present Position and Future Prospects. P. M. Sanders and E. K. Wenlock. *Diesel Eng. Us. Ass.*, S. 141.—This paper surveys the economic possibilities of the diesel engine for road transport.

After a brief recapitulation of the reasons for its economy in comparison with the petrol engine in this field, the effect of taxation changes on its development are discussed. Comparative costs of running different types of goods carrying vehicles on heavy oil and other fuels, both prior to the Finance Act of 1935 and at the present day, are presented graphically, showing how the cost per mile is affected by the total annual mileage covered. In the same way the economic possibilities of the diesel engine in the passenger-carrying field, both for public service and private cars, are presented.

In regard to future prospects for the road transport diesel, further advances along the lines of technical development already made, together with a reduction in initial engine cost, are confidently expected. Important developments in the production of smaller and lighter heavy-oil units which will put more economical working within reach of a greatly increased number of operators are also anticipated; in this connection mention is made of the possibilities of the high-speed, two-stroke diesel engine for road service, and of the value of forced induction as a means of increasing engine output, whilst reducing size, weight, first cost and fuel consumption. Priming of diesel engines with hydrogen is suggested as another possible means of improving the efficiency of heavy-oil combustion; figures showing the savings in fuel oil effected by the use of hydrogen injection are given in conclusion.

The discussion on the paper is appended.

E. F. C.

660. Mechanics of Flame and Air Jets—Part II. R. F. Davis. *Fuel Econ.*, 1938, **14** (148), 25–28.—The author develops a formula for the burning rate of powder fuel, and studies the relation between flame length and particle size. Grading of powders is taken into account.

A method is shown of plotting a flame characteristic indicating effect of fineness of powder, turbulence and burner design on losses due to unburnt combustible.

T. C. G. T.

Coal and Shale.

661. Coal Coking by Electricity. H. Stevens. *Fuel Econ.*, 1938, **14** (148), 10–12.—This process is apparently finding some support in America from those interested in rescuing bituminous coal from its precarious plight in that country.

In this process a mass of 30 tons, or more, of coal is placed in a retort with a starting fuse as a core. The fuse, consisting of coke particles, is necessary because soft coal is not a good conductor of electricity. Carbonization is begun by passing electricity through this fuse; the heat developed carbonizes the surrounding coal, which, in turn, becomes a heat-producing conductor, and so the carbonization proceeds to completion.

The process and its operation are quite fully explained, and the plant is illustrated diagrammatically.

Among the advantages claimed are: much larger retorts, easy discharge with a pusher, low installation and running costs, and space saving. The supporters of the scheme advocate the utilization of "off-peak" power.

The Detroit Edison Company are operating a 30-ton retort, which is giving better results than normal by-product ovens. T. C. G. T.

Economics and Statistics.

662. World Consumption of Petroleum Products and Related Fuels for Military Purposes. V. R. Garfias, R. V. Whetsel, and J. W. Ristori. *Petrol. Times*, **998** (39), 259.—Past efforts to estimate the world consumption of petroleum products have always necessitated accounting for a large balance as material placed in storage in countries outside the U.S.A. The total volume of such material not otherwise accounted for is now so great, however, that factors other than the building up of stocks must be the cause. A big factor in this direction is considered to be represented by consumption by the defence services, figures concerning which are not unusually regarded as secret by the authorities concerned. Basing their calculations on estimations of the number of units consuming petroleum products, and the average demands of those units, in the possession of the several principal powers, the authors have drawn up tables representing the consumption of petroleum products by the armies, navies and air forces of the world. In this way some 60,000,000 barrels are accounted for in the year 1937. The British Empire heads the list with a consumption representing nearly 20% of the total. H. G.

663. Motors and Motor Fuels in Sweden. A. F. Enström, A. Gabrielsson and C. A. Jacobsson: *Tekn. Tidskr.*, 16.4.38 (Automobiloch Motorteknik No. 4), 25–32.—Review of the Swedish motor fuel situation in relation to available motor types. Four types are considered—viz. gasoline, Hesselman, diesel and charcoal gas engines. These compare roughly as follows, rating a 5-litre gasoline engine at 100:

	H.P.	Weight.	Price.
Gasoline engine . . .	100	100	100
Hesselman engine . . .	95	105	200
Diesel engine . . .	85	120	235
Charcoal gas engine . .	70	160	180

Fuels for the first three categories are discussed from the point of view of supplies, bearing in mind that Sweden lacks both oil and coal. The available shale oil, whilst low in cetane number and pour point, and thus suitable as Hesselman fuel, is not sufficiently plentiful to afford a solution of the problem. Synthetic production will have to work with either wood or peat as raw material. A plant using wood is under construction, and the technical side of the question has been studied, but it is anticipated that the product will be expensive, and there are difficulties in connection with the collection and transport of the wood. The more promising raw material, peat, requires new industrial methods of production before it may be used to full advantage. Alcohol is considered to be important, but its manufacture should not be tied up with the sulphite–cellulose mills.

Much work has been done on the charcoal gas generators, and efforts to increase the volumetric efficiency by means of superchargers have been successful. Future work will include construction of a special two-stroke engine for this type of fuel. The Government has aided this construction by allowing considerable reduction in taxes.

Questions of internal production, either synthetic or from imported crudes, storage and import of liquid fuels, some of which may be regulated by law, should be considered in the light of existing and planned motor types, and while it is felt that Government interference should be at a minimum, it is not believed possible for synthetic production to compete with imported fuels without considerable aid in the form of tax reductions. A general increase in motor-fuel prices to achieve the same end, as has been done in Germany, is stated to be undesirable. R. F. S.

664. Some Considerations on the World Production of Petroleum. F. Demitrescu. *Ann. Min. Roumanie*, Feb. 1938, **21**, 49–52.—World production during 1937 is approximately 280,000 tonnes, an increase of 12·8% on last year. Since 1929 production has fluctuated considerably, but consumption has followed these variations. The increase in production is due largely to the U.S.A., whilst the U.S.S.R. has increased production only slightly and is well behind her planned estimate. Venezuela, Iran, the Dutch East Indies, Mexico and Irak have all improved. South America is considered to have important reserves, and geophysical work has suggested promising results in Venezuela, Colombia, Peru and Trinidad. In Venezuela drilling deeper than 2500 m. will be necessary to test geophysical forecasts. Gasoline production has now increased to 40% on the crude treated, as against 35–36% during 1928–1935. R. O. Y.

665. Petroleum Production in the United States in 1937. Anon. *Rev. Pétrolif.*, 11.3.38 (776), 309–310.—During 1937 the U.S.A. produced 1267×10^6 brls. of crude, 63·2% of the world's total, as against 1100×10^6 and 61·3% in 1936. Due to great drilling activity in 1937, discoveries of new deeper horizons and new fields show an increase of 55% on 1936. 357 discoveries, including 251 in unexploited regions, were made. This success is largely due to a marked increase in depths of wells, as shown by a table giving drilling success and depths in the various states in 1936 and 1937. The question of reserves is still a problem, but they have been increased to $14{,}363 \times 10^6$ brls., maintaining the increase of the past ten years. During the past the average production per well has increased markedly. As regards future discoveries, the outlook is hopeful —for instance, Illinois had reserves of 28×10^6 brls. in January 1937, which were increased to 150×10^6 in January 1938. The same applies to Arkansas. The efficiency of recovery has also increased during the last few years. Finally it is pointed out that refineries produced 50% gasoline on the crude treated in 1937, as against 33% in 1926. R. O. Y.

666. Importance of Turner Valley Oilfield. Anon. *Oil News*, 24.3.38, **43** (1321), 182–183.—Drilling in this area commenced in 1913, but small quantities of light oil were obtained from above the Palæozoic limestone, the present main producing horizon. From 1924 to 1934 the famous Royalite 1 produced large quantities of gas and naphtha.

Later wells have delineated a field 13 miles by ½ to 1 mile wide. Structural relief so far within the gas zone is 3718 ft., whilst the edge water has not yet been reached. During the period of drilling for naphtha several light oil horizons in the upper strata were encountered. Several wells from 1924 to 1936 produced small quantities of about 55° A.P.I. light oil. Drilling on the west flank of the structure has proved two oil zones. The first, in the north, proved by Model No. 1, which gives 44° A.P.I. oil, and the second, at the south of the structure, has an area of about 3 miles by ¾. Several of the naphtha-producing wells showed signs of changing over to very light crude oil. Smith separators were used for naphtha separation from the gas.

Proration has not been official, as it has been applied through necessity, owing to inadequate pipe-line facilities by the Imperial Oil Co., and does not apply to independent companies marketing their own products.

The Davies 2 well gave 3000 brls. of oil and 7,120,000 cu. ft. gas per day after treatment with 10,000 gals. of hydrochloric acid.

Production details of some of the more interesting wells are given. R. O. Y.

667. Petroleum Trade in Hungary in 1936–1937. G. Biro. *Monit. Petr. roum.*, 1938, **39**, 113–117.—The importation and consumption of individual petroleum products are closely analysed, and numerous tables illustrate the tendency of the petroleum business since 1926.

Of the 226,988 tonnes of petroleum imported during 1936–1937, 190,627 tonnes were crude oil, 31,010 tonnes gas oil and 4007 tonnes lubricating oil. Motor-spirit and lamp-oil imports are almost negligible. 222,417 tonnes of petroleum were consumed in 1936–1937, compared with 194,436 tonnes in the previous year. Motor-spirit consumption was 53,273 tonnes, and includes 10,006 tonnes of alcohol. Alcohol shows a steadily increasing consumption. Fuel oil enjoys the most rapidly increasing demand. Lubricating-oil consumption, at 12,834 tonnes, shows a substantial increase on the previous year. Incidentally, considerable attention is devoted in the article to the country of origin of the lubricating oils, about ten tables appearing on this point.

Of the 27,369,572 pengo raised in petroleum taxes, 45·4% was from motor spirit, 23·5% from kerosine and 20·7% from lubricating oil. T. C. G. T.

668. Roumanian Petroleum Industry in 1937. C. Osiceanu. *Monit. Petr. roum.*, 1938, **39**, 239–240.—The year 1937 closed in a less favourable state for the petroleum industry than 1936. Production in 1937 may be accepted as 7,200,000 tonnes, or an 18% drop on 1936, which was itself 3·7% higher than 1935. This 18% decrease in production is in spite of an 18% increase in drilling.

The greatest drop has been in the Bucşani field, where production has fallen by 1,213,238 tonnes, or 55·7%. This decrease is considered to be due to irrational exploitation.

The article explains the steps taken, both by extended drilling operations and improved operating technique, to counteract the decline.

The fall in production is affecting the refineries, which are now operating at only 55% of capacity.

The internal consumption of petroleum remains stationary in spite of great efforts by the industry to increase sales. The failure to increase the home market is deplored, and the blame is attributed to the excessively high taxes. It is also regretted that exports have been allowed to drop by 18% at a time when the foreign market for oil is good.

The author considers that cracking should be encouraged, and points out that only 14% of Roumanian spirit production is cracked, against 47% in the U.S.A.

T. C. G. T.

669. Oil Industry in Roumania, 1937. F. Demetrescu. *Ann. Min. Roumanie*, Jan. 1938, **21**, 33–36.—During 1937 production fell by 18%, due largely to a fall of 50% at Bucşani. Drilling activity has decreased Large numbers of wells have been drilled in old fields, such as Ceptura, Filipesti and Moreni. Good results have been obtained at Boldeşti-Pauleşti and at Tintea. At Margineni, 8 km. south of Moreni, high gas–oil ratios necessitate caution in production, and drilling has been restricted.

Refinery activities and consumption of the oil are discussed. R. O. Y.

670. Roumanian Oil Developments. Anon. *Petrol. Times*, 19.2.38, **39**, 235.—At Tintea three new wells have been completed in the Meotic sands on the north flank, but they are to be restricted, very wisely, to 100 tons daily. Ten wells are drilling, and six more rigs being erected. Wild catting has been very limited during the last few years in Roumania. The State is to devote attention to exploration, and it is expected that the New Mining Law will encourage more exploration this year. Roumania's production comes from a very small area indeed, while practically the whole of Moldavia, Bucovina, Ottenia and Transylvania remain unexplored. R. O. Y.

671. Undue Alarm over Roumanian Reserves. Anon. *Petrol. Times*, 26.2.38, **39**, 276–277.—Professor Macovei, director of the State Geological Institute, discussed, in a recent address, the Roumanian reserves. Producing areas stretch along the Eastern Carpathians from Poland to the Dambovita valley. Further possible areas lie to the west, and the Transylvanian gas-fields have not yet been adequately tested for oil. As a conservative estimate 25 years is stated to be the minimum life of the oil industry, not allowing for discoveries in the Southern Plains or in Transylvania. R. O. Y.

672. Success in Austrian Oil Search in 1937. Anon. *Petrol. Times*, 9.4.38, **39** (1004), 464.—The Goesting X. well has reached 1000 m. without result, but another well is to be started near by. The total Austrian production last year was 33,000 tonnes, and the contributions of various wells to this are given. The economic aspects of the installation of a cracking plant are discussed. R. O. Y.

673. Development of the Poza Rico Field, Mexico. Anon. *Petrol. Times*, 5.3.38, **39**, 293.—The official details of the agreement between the oil companies and the Mexican Government are given. It was proposed that the field be exploited in a unitary manner. A map of the field with the wells indicated is given, together with a key map of Mexican fields and exploitation areas. Part of the agreement was that companies commence drilling at Porterillos and Poza de Cuero. The area of Poza Rica is 6058 hectares. Analyses of the oil and results of cracking tests are given. R. O. Y.

674. Petroleum and the Brazil–Bolivia Treaty. Anon. *Rev. Pétrolif.*, 4.2.38 (**771**), 143.—The economic aspect of the situation is discussed. It is stated that G. Millanardi has reported favourably on an oil area in the S.E. of the State of Goyaz. The proposed Brazilian–Bolivian pipe-line will not serve the Amazon Basin, where large concessions are held but have been neglected owing to the absence of adequate facilities. Consequently this omission is criticized. Low-gravity oil shows are reported in Caupolican province, in the Rio Beno area. R. O. Y.

BOOK REVIEWS.

The Science of Petroleum. Volume IV, pp. 2839–2858. The Utilization of Mineral Oils and their Derivatives (being Part III, Section 40).*

Part III of *The Science of Petroleum* deals with the utilization of petroleum oils and their derivatives, and comprises Section 40 in Volume IV of the work. It contains a number of authoritative articles on motor spirits, kerosines, diesel oils, solvents, fuel oils, lubricants, waxes and asphalts, together with discussions on some of the special products of petroleum.

On attempting to review Part III, one realizes one of the main difficulties of the editors of such a work—the allocation of space to the various branches and subdivisions of the subject. Part III, describing the application of petroleum products, receives about 470 pages, or just over a seventh of the space in the whole work, in comparison with the largest section—on refining—which occupies two of the four volumes. This portion of the work is of particular interest to the marketer of petroleum products, and those engaged on the technical side of selling would have been glad to have seen this section enlarged to include treatment of a number of applications of petroleum which are barely mentioned, if at all, and to have permitted a more extensive description of the applications of such products as solvents and waxes.

The treatment of subject-matter in the various articles differs widely, in some cases being of a "practical" nature and accompanied by profuse illustrations, and in others being more of a literature review. Examples of the former type of article are those on fuel oils and their applications and on oil gas. These cover about 30 and 23 pages, respectively, and contain much informative detail and excellent illustrations. One could not wish these articles shorter, but can only regret that exigencies of space have presumably prevented similar treatment being accorded to more of the subjects discussed.

Some of the articles included in this section might fairly be regarded as belonging more appropriately to the refining volumes, as they deal more with the preparation of the products than with their utilization—*e.g.* some of those on synthetic derivatives of petroleum, carbon black, etc., which describe the methods and chemistry of production, but make only passing reference to their application. It is interesting to find such authoritative summaries of some of the less-known products, such as apiezon oils and ichthyol, but one misses reference to some of the other uses of petroleum products, such as, for example, printing-ink oils, which are of at least equal importance.

A critical review of this section, however, leaves the dominant impression of how well both editors and authors have combined in a very difficult task. It will shortly have become a fixed habit among petroleum technologists seeking information, to turn first to *The Science of Petroleum*, confident that if the subject is one of the many treated there, it will be dealt with so that, even if the inquirer has to go farther, the sources of information will be adequately indicated. Those also who are now entering the industry are extremely fortunate to have available such an excellent guide through the labyrinth of petroleum literature.

E. B. Evans.

The Science of Petroleum. Volume IV, pp. 2860–3076. Detonation and Combustion (being Part IV, Sections 41 and 42).*

Part IV of *The Science of Petroleum* comprises Sections 41 and 42, on Combustion and Detonation, respectively. The reader is taken in logical progress from a study of the fundamental work on the combustion of hydrocarbons at normal and high pressures, to a review of existing knowledge of knocking and its prevention, and the theory of knock in engines. In a detailed expansion of the subject, the subsequent articles lead in true sequence from slow oxidation processes preceding ignition, through three articles on ignition itself, to flame propagation and the actual behaviour of fuels and dopes, with finally articles on the measurement of knock and its effect on the engine. The treatment given is very full, and nearly 1000 references to original papers are contained in the bibliographies at the end of the articles.

* For General Review and Review of Vol. II see. *J.I.P.T.*, 1938, **24** (174), 198A–201A.

The article on " Oxidants and Anti-Oxidants " refers to no less than 153 researches on this subject, and includes a great deal of valuable data. In fact, it is so complete that some of the material included is really outside the scope of this particular section of the work.

Combustion in compression ignition engines is grouped with the two treatises on pure combustion research, and it might be thought that it could have been more logically placed after the treatment of combustion in spark-ignition engines. The practice in this article of giving the titles of the papers referred to is one which might have been followed generally, since it is of considerable assistance where it is desired to select original work for further reading.

The illustrations and tables throughout have been beautifully prepared and reproduced. Examples which stand out are the numerous photographs of flame propagation, detonation waves, and oil injection, whilst of much excellent tabulated data, that of knocking characteristics of pure hydrocarbons can be selected for special praise, providing as it does a volume of information in a few pages.

There is no doubt that the 216 pages of Part IV will be of the greatest value, not only to the petroleum scientist and student, but also to all who are interested in the internal-combustion engine, since no book previously has attempted to put together the enormous volume of original research on detonation. This part of the work will certainly be welcomed, and would serve an even wider use if it were available as a separate volume.

H. C. TETT.

The Chemistry of Petroleum Derivatives, Volume Two, 1937. By Carleton Ellis. Pp. 1464. Illustrations 350. Reinhold Publishing Corporation, 330, West 42nd Street, N. York, U.S.A. £5 net.

When this great work first appeared (see Review, *J.I.P.T.*, 1934, **20**, 1065) petroleum chemists rejoiced to find a careful, accurate and comprehensive publication that brought into a reasonable compass the vast accumulation of facts appertaining to mineral oil. It has stood on your reviewer's table for three years, and without exaggeration has been so valuable a work of reference that scarcely a day has passed on which it has not been consulted—and this is no uncommon experience. But it is very unlikely that any of us contemplated the production of a second volume in so short a time—a volume that deals in essence only with work published since 1934, and withal of the same substantial bulk as its forerunner. The work contains 1464 pages, 350 illustrations and 119 pages of double-column indices (name and subject).

It is astonishing to realize the continuous progress of the scientific advance of petroleum science. Carleton Ellis deals only with the chemical aspect. When one contemplates the endeavours of the physicist, the geophysicist, the engineer, in the production, erection, maintenance and transport, it may be appreciated that here is an industry, young and virile, that is so firmly established on a sound scientific foundation as to compare favourably with any other great human enterprise.

Since 1934 very much important new material has been published, and therefore a number of new chapters has been incorporated *inter alia* the synthesis of hydrocarbon material from carbon monoxide and hydrogen, the use of petroleum hydrocarbons in anæsthesia, asphalts and bitumens, the application of thermodynamics to petroleum products, sulphur derivatives in mineral-oil fractions, utilization of by-products, polymerization pyrolysis and the various methods by which synthetic hydrocarbon derivatives can be built up from simple molecular structures. The petroleum industry is on the very threshold of development that will establish it as the progenitor of a new synthetic chemistry. It is to such an invaluable treatise as that before us that we look for guidance in the future developments of the upgrading of the lower hydrocarbons that to-day are mainly superfluous materials.

Enough has been said to indicate the sterling worth of Carleton Ellis's great effort. It is in effect a veritable masterpiece. It would be absurd to use the hackneyed expression " This book is indispensable to the petroleum chemist." The plain fact is that he cannot afford to be without it.

It might be added finally that the general get-up, printing and production are admirable.

A. E. DUNSTAN.

Rotary Drilling Handbook. By J. E. Brantly, B.S., E.M. Pp. 335. Index pp. 337–350. Second Edition. Revised. 1937. Russell Palmer, New York and London. Price $3.50.

The issue of a second edition of this book has allowed the inclusion of certain additional data and matter not incorporated in the first edition, but now included in response to various criticisms and suggestions the author has received. As has been stated in previous reviews, the book deals solely with rotary drilling, and contains much useful information, practical hints and suggestions relative to choice of equipment, lay-out of plant and the technique of drilling. A perusal of the second edition reinforces the opinion formed when the first edition was issued that it should be within handy reach of all members of drilling staffs, superintendents and drillers alike.

The scope of rotary drilling is now so wide that the author must inevitably have experienced some difficulty in choice of material for inclusion, but has handled it concisely and with a view to ease of reference. Nevertheless, it is thought that the value of the book would be enhanced by the author's opinions and suggestions on certain aspects of rotary drilling, which have been omitted. A chapter on pressure drilling would be a useful adjunct. The technique of fishing has been somewhat summarily dismissed. Demands for higher slush-pump pressures are continually being made, and the author's views on how to meet them, whether by means of ram pumps or other improvements over present design, would be appreciated. If space is a primary object, it is suggested that the tables on pages 266–285, giving dimensions of standard tubing, could be omitted, as being readily available to the driller from other sources.

There is little doubt that the popularity of the book will be such as to call for a third edition, for which it is hoped the above suggestions will be considered.

H. W. Hole.

Marine Diesel Oil Engines. By J. W. M. Sothern, M.I.E.S., M.I.Mar.E. 2 vols. 5th Edition. Pp. 1134. Illustrations 716. 1938. Technical Press, Ltd., 5, Ave Maria Lane, Ludgate Hill, E.C.4. £2 10s.

The new fifth edition of this book now runs into two volumes covering 1134 pages, which are supplemented with numerous illustrations. The author's claim to complete revision, and the note on the cover stating that the work is now thoroughly up to date may, however, be questioned.

The book has undoubtedly been enlarged, but some may consider that whatever value it possesses would not have been diminished if much of the descriptive matter and illustrations relating to entirely obsolete types of engines had been omitted or replaced by descriptions of modern engines.

For instance, in Section I, dealing with main engine types, comprehensive descriptions are given of four-stroke Harland & Wolff and B. & W. air-injection-type engines, whilst the B. & W. two-stroke type, which has now practically superseded the four-stroke type, is only covered by a reprint from a paper read before the Marine Engineers in October 1936, by Dr. H. H. Blache and a reprint from *The Marine Engineer* describing the m/s *Duntroon* machinery. Similarly, full descriptions are given of the Cammell-Laird, Fullagar, Beardmore Tosi and Vickers engines, which are practically obsolete, whilst the main description of the Sulzer engine applies to a two-stroke air-injection engine of a type which has not been made for the past twelve years. There is very little to be learnt in this Section of developments which have taken place during the past decade.

In Section VII, under the heading of auxiliary engines, the descriptions are confined to a very old type of air-injection Mirrlees, Bickerton & Day engine, and to a number of hot-bulb engines, paraffin and petrol engines, all being of types rarely to be found in any motor-ships of the present day. It would appear only reasonable that during the revision of this book attention should have been given to modern developments of the airless-injection-type of engine now almost universally fitted in motor-ships, but no mention of this type of engine is made in this section.

On the subject of fuels and lubricating oils, under Section VII, there are many points requiring drastic revision and correction. For example, on page 417 an analysis is given of " good fuel oil " which is intended to " serve as a guide to chief

engineer officers who may perhaps require to order fuel oil abroad." This specification states with meticulous precision the percentage limits for carbon, hydrogen, oxygen, sulphur and nitrogen, but makes no mention of viscosity, ash content, asphalt or Conradson coke value, although the latter four characteristics are of much more importance than the elementary composition. This and similar specifications can only be regarded as thoroughly useless and unreliable guides to an engineer officer.

Incidentally, no mention whatever is made throughout Section VII of ignition quality or its method of test, and the B.S.I. Specifications are not even referred to.

In Section IX—Questions and Answers on Oil-Engine Practice—on page 626 it is stated that " sulphur in oil tends to induce pitting in exhaust valves and seats," and on page 629 that " sulphur in oil can be detected by the yellowish tinge in the smoke at exhaust (funnel); also by smell " !

On page 629 a specification of a good fuel oil suitable for diesel-engine purposes gives precise figures for the carbon, hydrogen and oxygen contents, whilst sulphur, asphaltum, water and ash are each specified to be 1% !

On page 410 it is stated that " refining extracts the impurities present, such as sulphur, oxygen and nitrogen, etc. " !

It is surprising to find on page 631, in answer to the question " What is gas oil ? " that " gas oil is obtained by the distillation of petroleum. It gives out a strong light and is chiefly used for illuminating purposes."

Practically all this information is incorrect and misleading, and can be of no help to a prospective marine engineer studying for his motor certificate.

On the subject of lubricating oil, on page 444 a specification is given for " good-quality lubricating oil " which quotes a Redwood viscosity at 140° F. of 633 seconds, whereas on the previous page the viscosity of " oils for cylinders and air compressors " is given as 140 seconds at 120° F. On page 633 there is still another recommendation which gives the viscosity at 122° F. as 5/6° Engler for forced lubrication. Such a multiplicity of contradicting recommendations must be very confusing to the reader.

In the final section of Volume I, dealing with auxiliary gears, etc., some paragraphs describing crankshaft alignment indicators are followed immediately by descriptions of Yarrow and Babcock & Wilcox boilers, and of the marking off of a ship for boring out for propeller shafting. The sequence seems confusing and much of the subject-matter irrelevant in a book purporting to deal with marine-oil-engine practice. Briefly, the book seems to call for drastic revision if it is intended to be of any service to an engineer and, furthermore, its value would be enhanced if the copious descriptions of obsolete engines were considerably reduced, and in many cases eliminated altogether.

L. J. Le Mesurier.

BOOKS AND PUBLICATIONS RECEIVED.

Petroleum Facts and Figures. 5th Edition. 1937. Pp. 245. American Petroleum Institute, 50 West 50th Street, New York. 75 cents.

This volume marks the resumption of the statistical survey of the American petroleum industry prepared by the American Petroleum Institute, of which the last issue appeared in 1931. A comprehensive series of tables and diagrams presents every important aspect of the production, refining, utilization, marketing and taxation of petroleum products in U.S.A. A very useful folding chart is included giving a list of principal petroleum products.

The final chapter deals with the organization, personnel and the Board and Committees of the American Petroleum Institute.

The Action of Hydrogen upon Coal. Part III. The Development of a Small-Scale Liquid Phase Continuous Plant. By N. Booth, F. A. Williams and J. G. King. Fuel Research Tech. Paper No. 44. H.M. Stationery Office, 1938. Price 9*d*.

This report gives an account of the development of a small-scale plant for the continuous hydrogenation of coal in the liquid phase. The essential part of the plant is the converter, consisting of a vertical cylindrical vessel of 3-in. bore and 35-in. internal height. The ground coal, made into a paste with heavy oil derived

from the process, is injected into the base of the converter, and fills it to a level determined by an overflow pipe. Compressed hydrogen at a pressure of 200–250 atm. enters by the same pipe as the paste, and after passing through the paste is removed from the top of the converter, taking with it a part of the oil produced. The remainder of the product is recovered from the material (the sludge), passing down the overflow pipe. The temperature maintained in the converter is of the order of 450° C.

A detailed account is also given of certain selected features of the plant and of the difficulties experienced during the development stages.

Disposal of Petroleum Wastes on Oil-Producing Properties. By L. Schmidt and C. J. Wilhelm. U.S. Bureau of Mines, Report of Investigations, 3394.

This paper represents work done under a co-operative agreement between the Bureau of Mines and the Kansas State Board of Health. Although the problem is far from solved, a certain amount of data has been acquired regarding disposal of petroleum wastes, including descriptions of methods now used to handle such accumulations with safety.

Resume of Problems Relating to Edgewater Encroachment in Oil Sands. By F. G. Miller and H. C. Miller. U.S. Bureau of Mines, Report of Investigations, 3392.

This report is a brief compilation of published data which show the need for additional research on the problem of increasing recovery efficiencies by more efficient utilization of the energy in the water underlying the oil in the majority of reservoirs.

British Association for the Advancement of Science: Report of Annual Meeting, 1937. Pp. xlix + 111. Index pp. 113–129. British Association, Burlington House, London.

The 1937 Annual Meeting of the British Association was held in Nottingham, September 1–8, 1937. This report contains the Presidential Address, the Sectional Presidents' Addresses and a scientific survey of Nottingham and District.

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Geology.

675. Oriskany in West Virginia. R. C. Lafferty. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 175–188.—The first well giving indication of economic production from the Oriskany in West Virginia was drilled in 1918; no commercial wells, however, were developed until 1930. By 1935, three fields in Kanawha Co. (Cooper Creek, Campbell-Davis Creek, and Elk-Poca) were proved, with an area of 43,000 acres.

The Oriskany Sandstone underlies nearly three-fourths of West Virginia. It has a thickness of probably more than 200 ft. in the northern part of the State, but thins out in the western part. There are indications that the sandstone was deposited on an eroded surface.

Where productive in the Kanawha fields, the deposit varies from 11 to 60 ft. in thickness, the "pays" being from 1 ft. to 28 ft. below the top. When present in greater or less thickness it has proved non-productive, this critical productive thickness being probably due to shore-line conditions during deposition.

Owing to convergence, anticlinal structures are shifted on the deeper horizons from their surface or shallow subsurface positions. Though this shifting is very slight on anticlines with N.–S. axes, it is as much as 2 miles on the N.E.–S.W.

Reflection seismograph survey work has been of great value in checking the structural attitude of the deeper horizons, and it is thought this method of attack will materially help in areas where water is considered to be present. G. S. S.

676. Oriskany as a Source of Gas and Oil in Pennsylvania and Adjacent Areas. C. R. Fettke. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 241–266.—The result of discoveries of relatively large volumes of gas in the Oriskany Sandstone in the Wayne-Dundee field, Schuyler County, in 1930, first directed attention to this formation as a potential source of gas in the northern Appalachian province.

Of Lower Devonian age, the Oriskany Sandstone is probably present along the entire length of its outcrop S.E. of the Alleghany front. In thickness a great variation occurs; in places the formation is relatively thin, in others it reaches 15–30 ft., whilst its greatest thickness is that proved in Tioga Co., Pennsylvania, where some wells drilled through 60 ft. of the rock. Physical characters of the Oriskany are given, together with screen analyses of four samples of the sandstone.

Much of the gas production has originated from eight pools situated in South Central New York and North Central Pennsylvania. The location, size, structure and other characters are fully described. In Eastern Ohio only two small pools occur where economic quantities of oil in the Oriskany have been obtained.

Analyses of connate waters from the sandstone from four widely separated localities are given. The paper concludes with a discussion on the possible reserves in the Oriskany in Pennsylvania. G. S. S.

677. Chester Rocks of Meade, Hardin and Breckinridge Counties, Kentucky. R. E. Stouder. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 267–284.—The Chester Series is divisible into three groups: Lower, Middle and Upper Chester. In Meade, Hardin and Breckinridge, however, these rocks have not been satisfactorily described or divided.

In the Lower and Middle Chester a series of alternating sandstones, shales and limestones occurs, but this alternation of sediments is lost in the Upper Chester, and as a group does not lend itself to subdivision; three fairly persistent limestones, however, occur.

A number of the formations in the Chester Series have been described and named in Indiana and other areas, and it is thought possible that these groups may be correlated with the sediments occurring in Meade, Hardin and Breckinridge Counties.

Stratigraphic sections and tables accompany the paper. G. S. S.

678. Geology of Tepetate Oilfield, Acadia Parish, Louisiana. M. Bornhauser and F. W. Bates. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 285–305.—Situated in the Gulf Coast salt-dome province of Louisiana, the Tepetate field was discovered in 1935 by the Continental Oil Co.

Since the completion of the discovery well numerous additional wells have been

drilled. The main producing sands were encountered at 8300 ft. from the lower *Marginulina* zone. This zone has in the past been placed in the Middle Oligocene, but more recent investigations tend to show that it may be Miocene in age.

The Tepetate field is a deep-seated salt intrusion, which has given rise to gentle folding of the overlying shallower formations. Although no major faults have been found within the field itself, some with great displacements were proved near the area. North of the field a fault of 600 ft. displacement was found. It is believed that these movements are closely connected with the formation of the Tepetate field, indicating that the present outline of the dome may be only a secondary feature in the development of the Tepetate structure.

Cross sections and structural maps of Tepetate accompany the paper. G. S. S.

679. Alaska Wildcat will be Drilled by Three Companies. L. P. Stockman. *Oil Gas J.*, 17.2.38, **36** (40), 35, 38.—The Bear Creek–Salmon Creek anticline on the shore of Cold Bay will shortly be drilled to test the Lower Jurassic and Triassic formations. Field work in this area has determined 2300 ft. of Lower Jurassic sediments which appear to conformably overlie the Trias. The beds dip in a N.W. direction, and have a general N.E. strike, but contain at least two lines of folding and faulting running parallel with the coast-line.

The Bear Creek–Salmon Creek anticline exposes deeply eroded Upper Jurassic rocks in its crest, and it is in this series that the only seepages known in the region occur. The S.E. flank of the structure dips at about 4° and the N.W. flank at 16°.

The other fold, the Pearl Creek Dome, is much sharper, and some shallow wells have been drilled on it, but the structure has not yet been thoroughly tested.

J. A. G.

680. Simpson Discovery in Callahan County. M. Tucker. *Oil Gas J.*, 3.3.38, **36** (42), 27, 34.—A well recently drilled about 10 miles S.E. of Abilene in Callahan Co. entered the Simpson Lime (Middle Ordovician) at 4369 ft., and was completed at 4389 ft. After acidizing, the well began producing at the rate of 1000 brls. per day. This discovery opens up the possibility of Ordovician production in the whole of West Central Texas. The producing horizon contains fossils older than the Mississippian, but not so old as the Ellenburger, and appears to be about 80 ft. higher than the Ellenburger production found in Bean No. 1 well to the north. J. A. G.

681. Deeper Developments in Torrance Field. J. A. Bermingham. *Oil Gas J.*, 24.3.38, **36** (45), 21–22.—A second producing horizon has been discovered in the Torrance Field. It has been termed the Del Amo Zone, and occurs at depths varying between 4780 and 5050 ft. according to the position on the structure. After leaving the old producing horizon the discovery well passed through 1300 ft. of Miocene sediments, and at 4817 ft. encountered a schist complex of pre-Jurassic age. Overlying this were 50 ft. of schist conglomerate which is thought to be of Middle Miocene age, and probably correlates with a similar horizon in the El Segundo Field, about 10 miles to the north. Above this there is a shale series, overlain by the Del Amo Zone, which consists of fine sands interbedded with shales.

Wells subsequently drilled in various parts of the field indicate that the new oil horizon reaches its maximum development in the Lomita Area, and is not present on the highest portion of the structure, but becomes progressively more sandy down dip. Edge-water occupying about one-half of the producing zone has been found in the S.E. portion of the area. J. A. G.

682. Ordovician Possibilities Revive West Central Texas District. H. H. Adams. *Oil Gas J.*, 14.4.38, **36** (48), 84, 85, 139, 142.—Production from the Ellenburger Limestone was first obtained in this area during 1919, and in a number of fields many wells are now being deepened to test this horizon. The structures in the Ordovician conform very closely with those in the younger formations, and also follow the N.E.–S.W. trend lines. Before the deposition of the Barnett Shales the area was folded in a N.E.–S.W. direction, and the fields developed on these trend lines are represented by noses on the east side of the Bend Arch and on the west side by terraces. It is suggested that the lines of weakness in the Ellenburger and pre-Cambrian are

responsible for the structures in the Bend Series. Much of the accumulation in this region appears to be due to conditions of lensing or porosity, and it is difficult to correlate this fact with the linear distribution of the fields.

Wells on several fields have been deepened to the Ordovician, and among those that have obtained production are Cisco Lake, Oplin and South Bend. J. A. G.

683. Possibilities in the Nebraska Panhandle. H. J. Cook. *Oil Gas J.*, 21.4.38, **36** (49), 35–36.—This area is a basin bounded on the east and west by buried ridges which converge northwards into the Black Hills. During the formation of the latter range of hills, the sediments in the basin were subjected to warping and folding movements which have affected the Tertiary as well as the older sediments. The regional dip is from N.W. to S.E., and the potential gathering ground extends for more than 100 miles.

The Tertiary is represented by about 1200 ft. of sediments containing a good development of Miocene and Pliocene. The older beds include several horizons known to be productive in adjoining basins, and were laid down at the same time and under similar conditions. It is concluded that there is every possibility of this area proving productive if suitable structures can be discovered. J. A. G.

684. Certain Newer Aspects of the Michigan Basin. R. A. Smith. *Oil Gas J.*, 31.3.38, **36** (46), 65–66.—The study of the Michigan Basin has been considerably hampered by the thick blanket of glacial deposits overlying most of the area, but information gradually accumulated indicates that movement within the basin had largely ceased before the beginning of Pennsylvanian times. Apart from local depressions the latter series are nearly horizontal.

Drilling has proved the presence of numerous N.W.–S.E. lines of folding in and around the centre of the basin. Some of them appear to be more than 100 miles in length, and this general direction seems to be so characteristic of almost every known fold that it is suggested orogenic forces compressed the basin from N.E. to S.W. It is also thought that the effects of such movement will have folded the sediments of Indiana and Illinois and give rise to similar producing structures to those in the Michigan Basin. J. A. G.

685. Western Canada Possibilities being Slowly Developed. J. S. Irwin. *Oil Gas J.*, 7.4.38, **36** (47), 18–22.—The foothills of the Rocky Mtns., which occupy S.W. Alberta and N.E. British Columbia, contain strongly folded and faulted Palæozoic, Jurassic and Cretaceous sediments. Eastwards these beds dip steeply into a deep syncline which extends from Central Montana to the Yukon area, and rise again in Eastern Alberta to form a broad arch which is a northern extension of the Sweetgrass Arch in Montana. From this structure the beds dip gently into Central Saskatchewan to form the Moose-Jaw Syncline, and rise again on the flank of the pre-Cambrian mass in E. Manitoba. Little exploration has been done in this syncline, but it is thought that the region may be worthy of closer study.

Structures favourable to oil accumulation occur throughout the whole of Western Canada, and oil has been discovered in rocks ranging in age from Upper Cretaceous to Devonian, but Permian, Triassic, Pennsylvanian, Silurian, and Ordovician formations have not yet been identified in any of the wells so far drilled.

Oil occurrences in the Cretaceous include the Athabaska oil sands, which are estimated to contain 500 million brls. of oil accessible to mining. Production from the Devonian has been found on the Moose Dome, 60 miles west of Calgary, and at Fort Norman. The Turner Valley field lies on an anticlinal structure which appears to have been thrust eastwards and is now lying several thousand feet above its true stratigraphical position. The oil is obtained from the Madison Limestone, and the limits of production have not yet been fully determined. J. A. G.

686. What are the Chances of Finding Oil-bearing Beds in Belgium? A. Renier. *Annales des Mines de Belgique*, 1937, **38** (2), 331–342.—The surface geology of Belgium is quite well known, and borings, pits and other excavations have provided a wealth of subsurface data. As a result of Late Carboniferous and Early Permian earth movements there is an important stratigraphical break from the Middle Carboniferous

to the Upper Permian. Above the unconformity is an apparently complete succession of Upper Permian, Trias, Jurassic, Cretaceous and Tertiary beds, but their development is not uniform everywhere. Pits and borings have yielded detailed information concerning the post-Palæozoic beds. The Haine basin with its Cretaceous and Tertiary beds is devoid of oil even on the anticlines.

Oil also seems to be absent in the Brabançon plateau area, where the structure is relatively simple and some of the rivers have exposed Palæozoic beds beneath the Tertiary and Cretaceous. To the east of this the post-Palæozoic cover continues, and faulting has dropped down the Palæozoic floor, so that at Molenbeersel a well was still in the Oligocene at a depth of 1050 m. Another well found red beds (Trias and Upper Permian) beneath the Lower Jurassic. The Cretaceous and Tertiary beds are water- but not oil-bearing; the Triassic facies is unfavourable for oil, but not so the Jurassic, and the base of the Permian, which is calcareous or dolomitic. Careful work is required in the Ruremonde trough before a decision can be reached.

South of the Sambre–Meuse to the Ardennes the post-Palæozoic cover is sporadic, and then it becomes more important, due to the sinking of the Palæozoic floor in the Paris basin. The beds penetrated by a boring at Longwy, a little south of the border, and which are also known at depth in Belgium, contain no truly petroliferous rocks, although poor bituminous shales of the Toarcian outcrop on and near the frontier.

The Palæozoic beds are more difficult to assess. In spite of extensive mining and boring operations, only small amounts of solid hydrocarbons and concretions with oily matter have been found, and these have no significance regarding the occurrence of true petroliferous beds. The Hardstoft well and the undertaking of geophysical surveys in eastern England are suggestive as regards the Carboniferous limestone, but it is probable that the Dinantian lies very deep, or is even inaccessible to the north and north-east of the Ruremonde basin. The position in the great Haine–Sambre–Meuse syncline is problematical. The structural complexities, mineralization and solution cavities indicative of strong water circulation are features against the preservation of oil in the Carboniferous limestone. In parts of the Ardennes pre-Middle Devonian beds are strongly metamorphosed, as are pre-Silurian beds on the Brabançon plateau, thus further restricting the possibilities. G. D. H.

687. Oil Possibilities of the Austrian Flysch. H. Vetters. *Montan. Rdsch.*, 1938, **30** (4), 1–6.—The similarity between the Alpine and Carpathian Flysch zones has often been noticed, but, whilst the Carpathian Flysch is very productive, little more than oil and gas shows have been found in the Alpine Flysch. If a primary origin is accepted for the Carpathian Flysch oil, then this difference cannot be explained. However, it is now generally accepted that the origin is to be found in the Salt Clays of the Carpathian foreland, and certain similarities exist between this series and the Schlier of the Alpine foreland. Various occurrences of oil and gas are described, and there is little doubt but that the Schlier has the properties of a mother rock. The widespread occurrence of gas with, at the most, only traces of oil, is ascribed to the effect of the intense folding. The oil remained more or less in its original position during these movements, whilst the gas migrated farther out into the foreland. The oil should therefore be sought at the edge of the Flysch and where the Flysch has over-ridden the Schlier. S. E. C.

688. Neogene Oil Deposits in Slovakia. L. Sommermeir. *Petrol. Z.*, 2.2.38, **34** (5), 1–10.—The Czechoslovakian oil occurrences lie in the Flysch girdle of the Carpathians and their marginal area. They fall into two groups: those in the Flysch (mainly Upper Cretaceous and Lower Eocene) and those in the Neogene.

The Sokolnice–Telnice deposit lies in the Carpathian foreland in the Brünn embayment. The producing horizon is a sandy series, some 20–30 m. thick, in the Helvetian. The oil is heavy and asphaltic, and differs from the other Neogene oils of the inner Carpathian basin. It is much more similar to the oil from Taufkirchen in Upper Austria.

The stratigraphy of the Gbely and Neyst (Hodonin) fields is described in detail. At Neyst there is an important oil horizon just below the top of the Upper Tortonian, and another near the bottom of the Middle Tortonian. At Gbely gas is found in the Lower Miocene, but there appears to be no important oil horizon there. Discordances

in the Middle and Upper Miocene and Pliocene appear to be limited to the margins of the basin, and no breaks are known in the sedimentation in the Neogene of the oilfield region. The Lower Sarmatian is very important. The second oil horizon in the Lower Sarmatian at Gbely is at the same stratigraphical level as that at Neyst. Conditions differ in the Middle and Upper Sarmatian. At Gbely the first oil horizon lies near the boundary of the Upper and Middle Sarmatian, whilst at Neyst there are two oil horizons in the Upper.

The region is crossed obliquely by uplifts on which Gbely and Neyst lie. These are cut by long major faults, and the accompanying minor faults give rise to the characteristic schollen structure of the oilfields.

With the exception of the crude from the Upper Tortonian of the deepest fault block, the general rule is for the oils to be lighter with increasing depth. Oils from different horizons, although varying with depth in each horizon, can be distinguished. The Tortonian oils have a paraffin base, whilst the Sarmatian oils are free of paraffins. The oil from the Middle Tortonian of the W. fault block which is brought against the Lower Sarmatian of the middle block is a mixed base oil derived from mixing of Tortonian and Sarmatian oils. S. E. C.

689. Petroleum in Albania. Anon. *Petrol. Z.*, 2.2.38, **34** (5); *Montan. Rdsch.*, 1938, **30** (3).—With the exception of a very small production from Pekisti, practically the whole of the Albanian crude comes from Devoli. The maximum depth of the producing zone is 600–800 m., and the monthly production is of the order of 200–300 tons. The productive series (Miocene) is 250–300 m. thick, and the number of oil horizons varies between 6 and 12. The crude has a high sulphur content and sp. gr. of 0·945. The wells are small, but will probably have a long life, and spacing can be as close as four per acre.

The principal oil occurrences in Albania are associated with the Tertiary of the Adriatic coastal zone. In the Devoli field Tortonian overlies an eroded Flysch anticline. There is a second important discordance between the Miocene and Pliocene. The limb of the Miocene syncline is steeply dipping, broken, and partly thrust over the Flysch. S. E. C.

690. Oil Discoveries in East Siberia. M. F. Glaessner. *Petrol. Z.*, 2.2.38, **34** (5), 17–18.—8000 sq. km. of prospective oil territory have been discovered on the N.W. flank of the Dschugdschur Mountains, 300 km. from the shore of the Ochotski sea. The oil is found in three horizons in the Lower Cambrian at a depth of about 250 m. Oil has also been discovered some 600 km. farther to the west, in the Olekminsk district. This again comes from Lower Cambrian strata, and a well is stated to have flowed freely for 17 days. Further investigations are to be made, but climatic conditions rendered work very difficult. The Lower Cambrian of these two areas is only slightly disturbed, and overlies and surrounds the crystalline rocks of the Aldan massif. S. E. C.

691. Petroleum in the Russian Platform. D. M. Preda. *Monit. Pétr. roum.*, 1938, **39** (6), 423–427.—The structure of the Russian Platform is discussed and a detailed account is given of operations in the district of Perm. It is stated that although the presence of petroleum in the Ural Occidental has long been known, operations are of recent date, as a result of investigations made on the advice of Gulkine, who noted a resemblance between the Western Ural zone and the Western Appalachian region of America. Favourable structures were found in the Ukrain, Moscow and Leningrad, but not all of these contained oil in commercial yields; satisfactory deposits were, however, found in the districts of Perm, Bachkirie, Samara and north of the Caspian. The discovery of petroleum in the valley of the Chussovaya and the presence of a favourable structure in the Upper Uralian at Gorodtki in 1929 resulted in the drilling of a number of wells. Production in this district between 1929 and 1935 was 54,700 tonnes, but this was reduced in 1936, and in 1937 production ceased. Indications of petroleum were found at a depth of 101–103 metres at the junction of the Chussovaya and Kama rivers, but no further indication was obtained on drilling deeper; similarly another well drilled in the Kama valley gave indications only in the lower Kungurien. Exploration of the district resulted in the discovery of the anticlinal structure Krasno-

kamsk–Severokamsk; this is 75 kilometres long, and forms an arch 10 kilometres wide with an incline of 1–3°. The anticline sinks 10 metres per 1000 metres, and shows bracky anticlinal waves on the crest, rising 20 metres with respect to the general slope of the inclination; the anticlinal axis is found here together with bracky anticlines at Krasnokamsk, Gorodtki and Severokamsk. The results of numerous borings led to the conclusion that four cycles of erosion occurred—namely, after the Dinantian, between Muscovian and Uralian, between Uralian and Kungurien, and sometimes between Kungurien and Kazanian. Between 1934 and 1937 40 wells were drilled at Krasnokamsk, only 8 of which were believed to be producing, 10 wells were in course of drilling, and it was planned to bring the number to 100 by January 1938.

The wells are 250 metres apart, and are not greater than 1000 metres in depth, but one well is to be taken to 1700 metres. Two petroleum-bearing strata were found, one in the Oolitic at 100–190 metres, in which the oil is not present in commercial quantities, and one in the sandstone at the base of the Medium Carboniferous. The sandstone is 100–150 metres in depth, and the wells yield 20–40 tonnes of oil per day when brought in, but this decreases to several tonnes, which is obtained by pumping. Several wells drilled a short distance from Krasnokamsk show that the anticline continues at the same slope, one well which has reached the Krasnokamsk productive horizon has not yielded oil. The reserve of petroleum in the entire Perm district is estimated at 22,000,000 tonnes, but the author considers this figure greatly exaggerated. Analyses of the petroleum and gas from the two horizons are tabulated. A. O.

Geophysics.

692. Determination of the Geo-mechanical Properties of Cores. H. J. Schoene. *Oel u. Kohle*, 1937, **13** (44), 1079–1082.—The properties considered are the modulus of elasticity, the velocity of propagation of longitudinal elastic waves, density, and porosity. For a better illustration of the significance of these properties a number of cores were taken from a well in Hanover and measurements made on each sample. They ranged in age from the Upper Mucronaten (Senonian) to the Lower Cenomanian and represented a total thickness of 1845 m. The value of each of the above physical properties is plotted against depth and their relationship to one another, to lithology, and to depth of burial is indicated. S. E. C.

693. Success of Electrical Prospecting. R. de Geffrier. *Rev. Pétrolif.*, 18.2.38 (773), 209–210.—Electrical coring was introduced into the U.S.S.R. at Grozny in 1929, and was of service in the delineation of faults and structure and the recognition of oil and water horizons. It was used at Baku in 1930 and from 1931 onwards in the Emba, Central Asia, Maikop, Georgia and, finally, the Ural region and Sakhalin. Since 1934 it has been available on all fields and all wells have been thus examined. It has been of value in assessing reserves, and the initial production of wells can, by this means, be predicted with reasonable success. Electrical coring has revealed oil horizons which are poorly impregnated or under low pressure, and has been of great service in the exploitation of wells by the technique of producing first from deep horizons and later from those at successively less depths. It has reduced the taking of cores almost to zero, and, in addition to saving time, is estimated to be responsible for economies amounting to scores of millions of roubles.

Electrical prospecting was also first used at Baku in 1929. Later it was used at Baku and in other petroliferous areas, particularly the Emba, Ural, Baikal, Kamchatka, etc. The Schlumbergers introduced seismic reflection methods in 1934 on the west flank of the Urals, in the Emba region and at Maikop. They were successfully applied in the Apcheron–Khodygi area in spite of the relief, the forests and the lenticular sands, and provided data for the preparation of structural maps.

G. D. H.

694. Testing Resistivity of Soil. R. L. Craig. *Petrol. Engr*, Feb. 1938, **9** (5), 80.—A description is given of the usual field equipment used for measuring soil resistivity, and in particular the various configurations of the electrodes used. Although the mathematical theories involved in the calculations have been developed for d.c.

methods, the use of commutated-rectified methods offers simplification of equipment. Details of the set-up of the complete apparatus, including a new type of disc commutator, and of the mathematical and empirical interpretations of the results obtained, are given. C. L. G.

Drilling.

695. New World's Drilling and Producing Records Established in California. W. A. Sawdon. *Petrol. Eng.*, April 1938, **9** (7), 58.—The Continental Oil Co.'s Well five miles west of Wasco, California, has reached a record depth of 15,004 ft. It was electrically logged to determine the most prolific strata, and a zone just below 13,000 ft. was tested in April. The initial production was 591 brls. in 24 hours through a ¼-in. bean. Casing pressure was 460 lb., tubing pressure 1350 lb. and 250,000 cu. ft. of gas accompanied the oil. With an increase of bean size to ¾ in. the well flowed at a rate of 3000 brls. of oil and 660,000 cu. ft. of gas per day with a pressure of 50 lb. on the casing and 400 lb. on the tubing.

This well has provided an opportunity to prove the adaptability of sub-surface equipment and instruments at depths never previously penetrated. An outstanding engineering operation was the cementing in two stages at a depth of 14,641 ft.

L. V. W. C.

696. String of 8¼-in. Casing 9634 ft. Long Set in Well in Rio Grande Valley, Texas. Anon. *Petrol. Eng.*, April 1938, **9** (7), 64.—One of the longest strings of 8¼-in. casing ever run in a well was successfully cemented at a depth of 9634 ft. in the lower Gulf Coast area.

The string had a gross weight of 430,000 lb., and in order to support this weight ten lines were rigged through the travelling and crown blocks. Despite the reduction in speed the string was run and cemented in 25 hrs.

Water was pumped direct from the boiler pits, and the pits were filled with 14 tons of ice and as much water as possible. The temperature of the water was reduced to about 40° as the slurry was mixed and pumped into the hole. After each 500 ft. of casing was run, fluid was pumped down the string to make sure that circulation was free, and when 5000 ft. of pipe had been run into the hole, circulation was maintained for 1 hr. before running the rest of the casing.

A total of 1000 tons of cement was used in cementing the string. L. V. W. C.

697. Examination of Mud-flush and Bit Samples. H. Pilger. *Oel u. Kohle*, 1937, **13** (44), 1127–1137.—From the point of view of saving time, reducing drilling costs, etc., an investigation was made to determine whether mud-flush and bit samples would give sufficient evidence to obviate the need for coring. The work was carried out on the strata at the E. and N.E. flanks of the Oedesse salt stock, and the problem was to differentiate the thick shales and sandstones of the Lower Cretaceous, Dogger, Lias and Rhætic. In addition to the actual examination of the samples, the rate of drilling in the various formations was determined by measuring the increase in depth every 10 minutes. It was found that at certain horizons, such as the Miocene brown coals and the junction between the Hauterivian and the Valendis, this yielded evidence of value when used in conjunction with other characteristics.

Cores and other samples were examined so that the characteristics of each formation could be tabulated. The tests included examination under the binocular microscope to note shape and size of particles, type of material present, etc.; shade and depth of colour of the streak; quantitative determination of the lime content with the Scheibler–Finkner CO_2 apparatus; specific weight; and heavy mineral content. It was concluded that it is possible to differentiate all the horizons without palæontological assistance. The practical application of this, however, is not so simple. The complications due to varying times for different-sized particles to reach the surface, the recirculation of some of the particles, caving, etc., are pointed out, and it seems that in a region of difficult tectonics such as North Germany the application of this method would be impossible. S. E. C.

698. Drilling Patents. W. L. Church. U.S.P. 2,109,688, 1.3.38. Pipe cutter of the rotating type.

J. W. Culbertson. U.S.P. 2,109,690, 1.3.38. Drift recording apparatus.

J. H. Howard. U.S.P. 2,109,903, 1.3.38. Valve for core drills.

F. J. Hinderliter. U.S.P. 2,110,127, 8.3.38. Rotating tool joint with a sealing ring of resilient material carried by the male part and threaded to enable it to be screwed into the bottom of the socket.

W. E. Nolan. U.S.P. 2,110,236, 8.3.38. A method of drilling and sealing oil and gas wells comprising digging a pit to a relatively impervious formation and sealing the bottom of the pit, then drilling for a limited distance below the bottom of the pit with the bore constantly maintained under high pressure. Then heating the walls to metamorphose the wall material for some distance around the bore, simultaneously coating the walls with an easily melted material which is not affected by crude petroleum to provide a sealing.

C. C. Brown. U.S.P. 2,110,355, 8.3.38. Well-setting tool.

H. C. Smith. U.S.P. 2,110,582, 8.3.38. Under-reamer comprising a body with an eccentrically placed shaft carrying a cutter. The shaft is moved longitudinally and rotationally, by hydraulic pressure.

W. E. Jones. U.S.P. 2,110,602, 8.3.38. Overshot fishing tool.

H. G. Texter. U.S.P. 2,110,779, 8.3.38. A well casing in which the factor of safety in tension of the joints in the upper portion is greater than the factor of safety of collapse of the lower portion.

G. A. Lowrey. U.S.P. 2,110,913, 15.3.38. Pipe cutting apparatus.

V. C. Posey. U.S.P. 2,111,076, 15.3.38. A reversing tool for unscrewing pipe in wells.

F. Swan. U.S.P. 2,111,464, 15.3.38. Under-reamer.

A. C. Catland. U.S.P. 2,111,751, 2,111,752, and 2,111,753, 22.3.38. Well-tool construction and cutter mounting.

W. E. Williams. U.S.P. 2,111,881, 22.3.38. Whipstock comprising two members, one having a deflecting surface and the other anchoring means. A pin holds the two members against sliding movement, and downward pressure of a predetermined weight will shear the pin to enable the other member to move by gravity into oblique positions to block off a hole in which it is inserted.

J. C. Stokes. U.S.P. 2,112,254, 29.3.38. Hydraulic counterbalance for drill pipes.

W. D. Davidson and G. Tremolada. U.S.P. 2,113,647, 12.4.38. Rotary swivel.

L. F. Baash. U.S.P. 2,113,821, 12.4.38. Safety joint for drill pipe.

R. H. Giesey. U.S.P. 2,113,883, 12.4.38. Fishing device for wells.

R. W. Lohman. U.S.P. 2,114,056, 12.3.38. A method for determining the character of subterranean formations electrically.

D. Ragland. U.S.P. 2,114,476, 19.4.38. A method of deflecting a hole by disposing in the hole a drill stem of lesser diameter than the hole and of flexible material, a portion of which is curved longitudinally. Applying sufficient weight to the stem to force the lower end against the bottom of the hole and to flex the material of part of the curved portion. Rotating the string in this condition forces the bit in the desired direction.

C. C. Brown. U.S.P. 2,114,521, 19.4.38. Method of completing wells.

J. Anthony. U.S.P. 2,114,988, 19.4.38. A slip socket having toothed gripping portions and slits alternately extending from the respective ends of the body and the toothed gripping portions. L. V. W. C.

Production.

699. Gulf Coast Now Directing Attention to Improvement of Lifting Methods. N. Williams. *Oil Gas J.*, 10.3.38, **36** (43), 42.—Increasing consideration is being given to the problems and conditions affecting production of Gulf Coast districts. Attention is being directed to the development and application of practices adaptable to particular conditions to enable the most efficient recovery of oil to be obtained.

Many problems particular to the Gulf Coast complicate the use of artificial production methods, and each well constitutes an individual problem.

In general, due to the more efficient flowing practices and to the higher gas pressures, the need for producing by artificial means has been limited.

The loose, silty sands which characterize the producing horizons bring problems to the fields now pumping even though well screens are used. Steeply dipping sands accentuated this problem. Frequent cleaning out is necessitated in many fields, and replacements and repairs to cut-out pump parts constitute major items of cost, but much of these are being minimized by improvements in design and construction and in materials.

Water is another problem, although in some cases its presence may be an advantage. Many fields in the Gulf Coast are water-driven, and the water, moving constantly from the hydrostatic head, flushes the sands of its remaining oil.

It is expected that during the coming year a substantial number of wells in the Conroe field will be placed on gas lift. Most of these are around the edges in areas where the sand is badly broken and faulted and in which heavy withdrawals were made. L. V. W. C.

700. Completing Wells by Reverse Circulation in East Texas. F. G. Beckman. *Oil Gas J.*, 10.3.38, **36** (43), 44.—Advantage has been taken of using the column of fluid which has the highest velocity to carry out cuttings and debris in developing the reverse circulation method of drilling.

If the cuttings are to be carried out properly the velocity of the fluid becomes of primary importance rather than the volume. Low velocities of flow enable the cuttings to accumulate until they are worn into small particles, or until they have mixed with the drilling fluid to produce mud. They are thus floated out rather than carried. No accumulation occurs when the velocity is such that the cuttings leave the hole at the same velocity as the fluid. The velocity of the fluid required varies with the size and the specific gravity of the cuttings, and also the specific gravity and viscosity of the circulating fluid. If the velocity of the fluid stream carrying the cuttings is sufficiently increased, the cuttings will block off from one formation to the other as they are cut, and a mixture of the cuttings from the various formations does not result.

Special pack-off heads have been built to pack off between the casing and the "kelly" in order to get reverse circulation.

A small rotary table has been devised for driving the tubing that is used for drill pipe.

The method of operation is given in detail, together with the advantages of this process applied primarily to completion work. L. V. W. C.

701. Flooding and Brine Disposal Methods in Mid Continent. P. Reed. *Oil Gas J.*, 17.3.38, **36** (44), 84.—Water flooding and brine disposal are carried out in areas distinctly separated from each other. Both types of injection have a common problem in the treatment of water or brine for the purpose of putting it into the condition where no deposits will form in the injection well to plug the formations.

Cheap and effective water treatment is necessary, and several different methods have been adopted.

In the main, water flooding has been practised as a method of secondary recovery, but in two projects in Kansas it has been applied as a means of primary recovery.

Flooding costs in the Mid-Continent are being reduced by improvements in the technique brought from Pennsylvania, and it is expected that higher yields will be obtained. One project which is being tested is that of injecting gas into the property during the months immediately preceding the water flooding. Control of rate of production by means of electric-motor-driven jacks and the development of equipment which will make it possible to drill a large number of shallow wells more cheaply are the projects being studied.

Due to the possibility of the brine, injected into wells during brine disposal, depositing material in the pores of the sands, and so reducing the capacity of the well for receiving brine, steps have been taken to prepare it for underground injection to prevent deposition of plugging materials.

Several plants are available, aeration and stabilization being the principle treatments. L. V. W. C.

702. Squeeze Cementing for Controlling Gas Oil Ratios of Wells. C. P. Parsons. *Oil Gas J.*, 1.3.38, **36** (44), 103.—Squeeze cementing means the forcing of cement by pressure into or against a permeable formation, or through perforations in casing and liners for the purpose of shutting off water or for reducing gas–oil ratios.

The earliest method of squeezing cement slurry into wells was merely to place the slurry through tubing and to impose pump pressure on the well.

Better cementing technique, better cementing equipment to handle high pressures, special cements, self-sealing fibred cements, packers, etc., have been among the developments which lead up to the present form of squeezing.

Any obstruction at the face of a formation is first broken down by pumping water or acid into the formation. When the pressure necessary to begin movement of water back into the formation reaches a minimum the necessary amount of cement slurry is mixed and pumped down through the tubing and squeezed against the formation. The cement slurry follows the water into the formation, and starts building up a pump pressure. When the pump pressure reaches a maximum the squeeze is complete.

The methods of squeezing cement in open formation and cementing casing and blank liners are also given. L. V. W. C.

703. Burning Gas Well Finally Brought Under Control. B. Smith. *Petrol. Eng.*, April 1938, **9** (7), 90, and *Oil Wkly*, 4.4.38, **89** (4), 19.—The cratered well in the La Blanca field, Texas, which has been burning since January 8th, has now been controlled.

A 20-ft. smoke-stack was dropped over the exposed casing-head to force the flames to burn higher, thus reducing the temperature at the bottom of the crater where work was being carried on.

The crater was flooded with water from a near-by canal and the water was allowed to rise within 5 or 6 ft. of the top of the stack. Some water was then pumped out of the crater and the stack raised to allow the gas to flow through the water. In passing, the gas absorbed water and the fire was extinguished immediately.

Unfortunately during further operations the well again caught fire. This time it was extinguished by a charge of nitroglycerine, and after the crater had been cooled sufficiently, a new Christmas tree was stabbed into position. L. V. W. C.

704. Production Methods in Germany. O. Deicher. *Oel u. Kohle*, 1937, **13** (44), 1083–1127.—The methods used in the Nienhagen field are considered more particularly. Reservoir conditions are discussed, and the need for coring is emphasized. Cement is usually placed up to a height of 100–200 m. behind the casing. Perkins, full-hole and some special methods of cementation are described. Bakelite shoes are used to facilitate drilling out, and have proved successful. The height to which cement has been placed may be determined by Schlumberger temperature measurements, whilst the shut-off is tested by bailing and then a pressure test of 35 atms. Cementing and packing-off of watered horizons are also described. In low pressure, porous sands drilling is continued with mud until the top of the sand is reached. This enables the Schlumberger electrical coring tests to be made. The drilling-in is then completed with oil. In the case of soft sands such as the Valendis, the well may be drilled in with mud and then reamed out, using oil for the latter operation. The type of mud to use when drilling-in to high-pressure sands is briefly discussed. A short

account is also given of the Schlumberger electrical coring and of the Martienssen high-frequency borehole survey.

Gas-lift and pumping are dealt with in detail. Normally each well has its own compressor. Heating the gas to overcome deposition of wax in the well has not as yet been successful. The method usually adopted is to pull and change the tubing. The wax does not accumulate below a depth of 400–500 m., and this amount of tubing can be replaced in 10 hrs., the interval between replacements being 3–8 weeks. A special device incorporating a foot-valve with a bean above it has been some success at Nienhagen, the object being to reduce back pressure on the sand. The gas is passed down outside the bean, the oil returning through it. Intermittent gas-lift methods have not been attended by much success at Nienhagen. Shooting, acid treatment, re-pressuring, water-flooding, injection of superheated steam, and sub-surface heating receive brief mention, and finally such factors as the use of production curves and the supervision of production are discussed. S. E. C.

705. Production Patents. G. E. Lagan. U.S.P. 2,109,546, 1.3.38. Tubing control head.

D. L. McDonald. U.S.P. 2,109,731, 1.3.38. A strainer for wells comprising a number of identical, perforated, cylindrical sections adapted to be connected at various positions in the casing.

L. H. Hayward. U.S.P. 2,109,745, 1.3.38. Well-testing apparatus.

F. A. Thaheld. U.S.P. 2,109,913, 1.3.38. Well swab in which the resilient swab cups have a continuous support and each cup is individually supported against undue distortion by compression and expansion.

W. F. Cox. U.S.P. 2,111,172, 2,111,173, 2,111,174, 2,111,175, 2,111,176, and 2,111,177, 15.3.38. Oil well pump.

G. T. Humphrey. U.S.P. 2,111,591, 22.3.38. Pumping device of the walking-beam type having a pivotal mounting which moves transversely of its axis in a fixed horizontal plane in its support.

C. E. Lee and H. J. Craig. U.S.P. 2,111,793, 22.3.38. Apparatus for arranging a liner in a well comprising means for lowering the liner to the desired position and a hold-down tool for engaging the interior of the liner to hold it against upward movement.

A. J. Mason. U.S.P. 2,111,982, 22.3.38. Liquid sampler for wells.

C. Guinn. U.S.P. 2,113,508, 5.4.38. Quick-action coupling for pumping wells.

A. S. Parks. U.S.P. 2,113,856, 12.4.38. Well production-tester.

C. E. Van Stone. U.S.P. 2,114,090, 12.4.38. Pump-rod spacer and turner.

W. K. Edwards. U.S.P. 2,114,372, 19.4.38. Flow preventer for oil wells.

J. L. Hall. U.S.P. 2,114,765, 19.4.38. Intermittent flow valve.

W. F. McMahon. U.S.P. 2,114,905, 19.4.38. Venturi-tube oil-well pump.
L. V. W. C.

Crude Petroleum.

706. Analysis of Maverick Springs, Wyoming, Crude Oil. Anon. *Petrol. Engr*, Feb. 1938, **9** (5), 88.—A fresh sample of Maverick Springs crude oil has been examined by the Bureau of Mines, and is compared with that of a sample obtained in 1930, which represented material stored in the field for some time, and which was described in Bureau of Mines Technical Paper 538. The recent sample on Hempel analysis gave the following yields of products: Total gasoline and naphtha 8·5%, kerosine 9·7%, gas oil 12·7%, non-viscous lubricating distillate 14·2%, medium lubricating

distillate 11·5%, viscous lubricating distillate 2·9%, residuum 40·3%. The earlier sample had apparently lost by evaporation nearly all of the material distilling to 200° C. C. L. G.

707. Patents on Crude Oil. C. M. Blair. U.S.P. 2,110,837, 8.3.38. M. De Groote. U.S.P. 2,110,846–2,110,849 incl., 8.3.38. Demulsifying agents for breaking emulsions of the water-in-oil type. W. S. E. C.

Gas.

708. Texas Gasoline Recovery System. A. L. Foster. *Nat. Petrol. News*, 23.3.38, **30** (12), R. 121.—13,600 of the 25,000 wells in the East Texas field have been linked up in a gas-collection system which is handling 85–100 million cu. ft. of natural gas per day. Eight recovery plants, working on the compression/absorption system or the vapour rectification system, recover up to 7 gals. of 50–90 Reid vapour pressure material per million cu. ft. The recovered material is delivered, through meters, to a pipe-line system which transports it to the Texas Coast where it is separated into natural gasoline, "bottled gas," or polymerization-unit charging stock. The stripped gas is used as domestic or industrial fuel. As yet little propane is recovered, for economic reasons, but the plants, as at present equipped, are capable of recovering 40% of the available propane. H. G.

709. Drying Air and Commercial Gases with Activated Alumina. R. B. Derr. *Industr. Engng Chem.*, 1938, **30** (4), 384.—Activated alumina is shown to be suitable for drying air and commercial gases in various industrial processes where extreme dryness is required. A gas passed through activated alumina may be dried to contain not more than 0·002–0·005 mg. of moisture per litre; this is the moisture content of air in equilibrium with ice at − 70° and − 64° C., respectively. The development of activated alumina and of improved equipment suitable for its commercial use has resulted in new gas drying and dehumidifying processes which are broadening the industrial applications where removal of moisture can be accomplished economically. The temperatures developed in the adsorbent by the heat of adsorption may exceed the boiling-point of water, and elimination of this heat increases the capacity of the adsorbent. Complete drying and partial dehumidification are discussed. H. E. T.

710. Patents on Gas. G. W. Johnson. E.P. 480,781, 24.2.38. Manufacture of acetylene from hydrocarbons containing > 2 carbon atoms in the molecule.

V. E. Feeny. E.P. 481,059, 4.3.38. Reduction of SO_2 to S by introducing SO_2 into a reducing fuel bed consisting of carbonaceous substances. The sulphur forms COS with CO, and clean SO_2 is added to form a gas mixture which is subjected to catalysis. W. S. E. C.

Cracking.

711. Cracking, Polymerization and Natural Gasoline Recovery Combined in Single Plant. D. H. Stormont. *Oil Gas J.*, 31.3.38, **36** (46), 46.—Shamrock Oil and Gas Corporation during the past year placed in operation a plant in which the three processes are combined. The equipment for each operation comprises a separate unit, but all are located on the same site, and the products or by-products from one unit are processed in the others. The main objects were to improve the quality of the motor fuel, to bring the cracking and natural gasoline plants up to date and to utilize the relatively high amounts of propane and butane in the available gas to the best advantage.

The polymerization unit is of the catalytic type licensed by the U.O.P. It consists of a butane cracking unit in which some 50% of the pure butane charge is converted into unsaturateds on a once-through operation. The vapours pass to a condenser, a demethanizing column and a debutanizing column, and are then heated to correct

temperature and charged to the catalyst towers, which are packed with a solid granular phosphoric acid catalyst. The product from the towers is fractionated to finished catalytic polymer gasoline of the following properties: A.P.I. grav. 66·1°, I.B.Pt. 85° F., F.B.Pt. 446° F., Octane number A.S.T.M. 87, Reid V.P. 10·8 lb./sq. in., sulphur content 0·009%. The overheads from the final stabilizer and the unconverted butanes from the debutanizing column are mixed with caustic washed butane from the natural gas plant and charged to the butane cracking unit. A pyrolitic polymer is also produced as bottoms from the debutanizing column and its properties are: A.P.I. grav. 49·2°, I.B.Pt. 117° F., F.B.Pt. 517° F., Reid V.P. 4·8 lb./sq. in., Octane number A.S.T.M. 75, sulphur 0·20%. On account of its high gum content it is passed to the Dubbs cracking unit.

A full description is given of the flow of cracked butane vapours, of the processing of the vapours in the polymer plant, and of the method employed for reactivation of the catalyst.

Approximately 2100 brls. of combined feed, of which 1100 brls. is fresh butane, is charged daily to the butane-cracking unit. The yields of catalytic and pyrolytic polymers are 26/28% and 3/5%, respectively. The operation of the natural gasoline plant is described, and an analysis given of the Panhandle dry gas used as feed. The cracking plant is a 2000 brl. Dubbs unit of conventional design, using topped or fresh crude as feed stock. Operation differs slightly from the normal, since pyrolytic polymer is charged to the cracked gasoline stream in the flash-chamber, the stabilizer discard is charged to the debutanizing column of polymerization unit after caustic washing, and also uncondensed cracked gases are compressed and charged to the unit, instead of being burned as fuel as in ordinary practice. A simplified flow diagram of the polymerization unit is provided. R. A. E.

712. Production of Fischer–Tropsch Coal Spirit. C. S. Snodgrass and M. Perrin. *Petrol. Times*, 26.3.38, **39**, 395.—The drawbacks of the low octane number of the material produced by the Fischer–Tropsch process have been overcome by combining the process with the True Vapour Phase process. Details of a plant operating in Germany are given. Vapours from the Fischer–Tropsch synthetic crude are directly heated by intimate contact with superheated inert carrier gas, known as cycle gas, a product of cracking within the system and operating in a closed cycle. H. G.

713. Patents on Cracking. C. A. Edwards. U.S.P. 2,112,149, 22.3.38. Cracking of hydrocarbon oils in a tubular chamber the main portion of which extends horizontally and is adapted to contain molten metal. Petroleum is projected into the bottom of the chamber and a plurality of risers is provided communicating with the chamber. W. S. E. C.

See also Abstract No. 720.

Hydrogenation.

714. Production of Aviation Fuel by High Pressure Hydrogenation. C. L. Brown and J. A. Tilton. *Oil Gas J.*, 31.3.38, **36** (46), 74.—The domestic market for aviation fuels favours naphthas of high natural stability and lead susceptibility. Until recently straight-run naphthas of octane number 72/75 A.S.T.M. prepared from selected crudes have been almost universally used.

Through the development of new types of catalysts, which possess high resistance to poisoning and long life, the hydrogenation process is able to produce high-octane aviation fuels similar in properties to the straight-run fuels.

The plant and method of operation are basically the same as described previously for the manufacture of lubricating oils, kerosine and motor gasolines. Feed stocks used for experimental and commercial production had the following properties: A.P.I. grav. 26·1°/34·6°, I.B.Pt. 211/327° F., F.B.Pt. 544/601° F., and comprised cracked cycle stocks and heavy naphthas.

Oil feed and hydrogen are separately compressed to 200 atmds. and then mixed, passed through heat exchangers, heated in a fired coil and then passed to the catalyst chamber, where conversion takes place. The reaction products pass via heat exchanger and cooler to a high-pressure separator, where unreacted hydrogen is dis-

engaged and then recycled. The liquid hydrogenated product is released to lower pressure, stabilized by removal of all lighter than butane and part of the butane fractions, and the stabilized product is distilled to produce aviation distillate and cycle stock. The aviation fuel needs only a final caustic wash. A process flow-sheet is given. Cooling of the reaction mixture passing through the catalyst chamber is effected by introduction of recycle hydrogen gas at suitable points.

Commercial production of aviation fuels by high-pressure hydrogenation is in operation at the Baton Rouge refinery of the S.O.C. of Louisiana. Typical inspections of the naphthas produced are : A.P.I. grav. 65·3–66°, Reid V.P. 6·7 lb./sq. in., I.B.Pt. 109–115° F., % over at 167° F. 28–30·5, % over at 212° F. 63–68, F.B.Pt. 290–295° F., Octane number A.S.T.M. 75·8–76·0. Results of experimental runs on a number of charging stocks are also tabulated. The aviation fuels are characterized by low sulphur content (0·001–0·007%), low acid heat values, and marked lead susceptibilities. The octane numbers A.S.T.M. range between 75 and 78. Heavy naphthas or light kerosines of naphthenic or aromatic source have been found to be preferable feed-stocks from the standpoints of octane number and plant capacity.

Comparison is made of commercial hydrogenated and virgin aviation fuels in respect of conventional inspection tests which show marked similarity except for lower sulphur content and higher octane rating of the hydrogenated fuel. Lead susceptibility tests carried out on the two fuels by various methods are tabulated, and may be illustrated :—

OCTANE NUMBERS.

	A.S.T.M.	U.S. Army.	British Air Ministry.
Virgin	74·1	72·8	74·7
Virgin + 3 mls. T.E.L./Gal.	88·6	90·2	88·7
Hydrogenated	76·5	76·0	76·5
Hydrogenated + 3 mls. T.E.L./Gal.	90·4	92·7	90·5 *

* = 2 mls. T.E.L./Gal.

Sulphur contents and octane ratings of narrow fractions of the hydrogenated fuel are reported, and show even distribution of sulphur and generally decrease in octane number with increase in boiling point. The preparation of 100 octane fuels with the use of hydrogenated aviation fuel, *iso*pentane and (*a*) hydrogenated dimer, (*b*) hydrogenated co-dimer, with addition of 3 mls. T.E.L./gal. has been investigated and inspection data of the blends are provided. The blends comply with the requirements of the specifications of the U.S. Army and the British and French Air Ministries. R. A. E.

715. Patents on Hydrogenation. G. W. Johnson. E.P. 481,607, 15.3.38. Manufacture of motor spirit by hydrogenation of propane, butanes, pentanes or their mixtures at 500–600° C. under a pressure of 100–600 atms. using a tungsten–nickel sulphide catalyst.

M. Melamid. U.S.P. 2,110,887, 15.3.38. Conversion of liquid bituminous substances into lower-boiling products by dissolving about 0·1% or less of thallium colloidally into the substance undergoing conversion, injecting the mixture together with hydrogen in the atomized state into a reaction chamber and subjecting the charge to 5–20 atm., pressure at 400–460° C. W. S. E. C.

Polymerization.

716. Synthesis of Lubricating Oil by Polymerization of Gaseous Hydrocarbons. R. Fussteig. *Petrol. Engr*, Feb. 1938, **9** (5), 120.—A review is presented of the literature on the synthetic production of lubricating oils and on their chemical composition. This has been studied in an investigation of the simultaneous preparation of moto fuels of high anti-knock value and lubricating oils of high value by polymerization.

Two general methods for the synthesis of cyclic compounds of lubricating quality are: (1) direct synthetic preparation of cyclic compounds with aliphatic hydrocarbons, (2) transformation of open-chain hydrocarbons into cyclic compounds, followed by reaction with aliphatic hydrocarbons. The first method is of little value to the oil industry, owing to the absence of cyclic compounds in natural gas, but would be of great interest to the coal industry. For the second method to be of value to the oil industry a double process must be used in which aromatic and aliphatic hydrocarbons are first formed, and then caused to combine to give lubricating oils. The Fischer–Tropsch method is based on this, consisting of "splitting" natural gas into CO and H_2 and reacting them in the presence of a catalyst, the more H_2 in the "split" gas the lower the yield of olefins. As natural gas normally gives a "split" gas containing an excess of H_2, the addition of CO_2 is suggested to increase the yield of CO, but this, however, would not be an economic process. Oxidation, however, in the presence of a suitable catalyst could be used to reduce the H_2 content. Reaction of the CO and H_2, then, should produce two types of liquid hydrocarbons: (1) a gasoline fraction rich in olefins, and (2) a gas-oil fraction largely saturated in character.

The second liquid is considered suitable for the synthesis of lubricating oils, by combination with cyclic compounds. The synthesis proposed consisted of chlorination of the liquid, followed by mixing with 2 parts of aromatic hydrocarbons and 10% of Al_2Cl_6. Fractionation of the resulting product followed by clay bleaching yielded an oil of high lubricating value.

The process presents many difficulties to the oil industry, and for economic reasons the production of the aromatic hydrocarbons from olefin hydrocarbons would be desirable. This has been studied, and by choosing the right conditions a yield of 75% of aromatics is obtainable from the "split" natural gas. By using the residue from the distillation of the polymerization product as chlorinating product and condensing this with aromatics in the presence of Al_2Cl_6, synthetic lubricating oils of high lubricating value and oxidation stability, but low viscosity index, have been produced. It is suggested that the chlorination should be carried out until the trichlor is obtained. C. L. G.

717. Utilization of Refinery Gas of Increasing Importance. H. S. Norman. *Oil Gas J.*, 31.3.38, **36** (46), 78.—A new field which has been explored on a semi-commercial basis is that of producing aromatics from petroleum gases. A plant for the continuation of the work already carried out by the Pure Oil Co. and Alco Products was built at Toledo for the purpose and has been running for several months.

Thermal polymerization of refinery gases for production of sulphur-free aromatic motor fuel as well as the three main aromatics, benzol, toluol and xylol, is carried out in the plant, which has a capacity of about 100 brls. of aromatics per day. Gases charged consist of a mixture of saturates and unsaturates from vapour-phase and liquid-phase cracking plants. The liquefied charge is prepared from the gases, and the composition can be varied over a wide range. Polymerization under pressure of 60–300 lb./sq. in gauge and with temperatures varying from 1050 to 1350° F. has been carried out. Studies indicate (1) ethylene is not converted in high percentages to aromatics, but propylene is the main constituent undergoing transformation; (2) distillates are currently obtained with about 20% benzol, 13% toluol, 7% xylol, the remainder being non-aromatic; (3) changes in composition of feed stock within a reasonable range are substantially without influence on the proportions in which the individual aromatics are formed; (4) yield of aromatics relative to total distillate increases with increasing temperature, whilst total yield of distillate increases with decreasing temperature; (5) at higher temperatures the purity of the aromatic cuts increases markedly; (6) methane and ethane give practically no conversion to aromatics under the conditions of operation, and it is felt that treatment in the presence of an active catalyst will be necessary. Still another source of aromatics is the by-product liquid produced when operating gas cracking units on propane or butane at high temperatures, and which contains about 20% of aromatics.

Polymerization has also been utilized in order to remove the natural limitations of charging stocks. Crude oils which may have limitations of quantity or quality of gasoline can often be converted into satisfactory charging stock by inclusion of selective cracking and polymerization in the refinery. As illustration, the operation of such a combination refining unit installed at La Plata, Argentina, is described.

R. A. E.

718. **Patents on Polymerization.** L. Horton. E.P. 482,276, 21.3.38. Polymerization of olefines to produce lubricating oil in three stages. In the first stage the olefines are polymerized at 300–350° C. to form highly unsaturated products using as catalysts phosphates of Al, Cr, Ce or Ba, chromates of Ba or Pb, barium perchlorate, formic, molybdic and phosphomolybdic acids, ammonium phosphomolybdate, Al–Hg couple, cobalt-thoria mixtures which are placed on Kieselguhr or alumina gel as supports. The unsaturated products formed are heated in the second stage without distillation or fractionation at 200° C. at or above atm. pressure in the presence of aluminium chloride or boron fluoride. In the last stage the supernatant oil is separated from the tar by decantation and refined to produce lubricating oil.

Phillips Petroleum Co. and A. H. Stevens. E.P. 482,271, 24.3.38. Preparation of normal olefines containing 1 and 2 olefines in concentrated form from hydrocarbon mixtures containing tertiary and other olefines by selective polymerization and subsequent acid treatment. W. S. E. C.

See also Abstract No. 711.

Refining and Refinery Plant.

719. **Lead Sulphide a Doctor and Dry Sweetening Agent.** J. Happel and D. W. Robertson. *Oil Gas J.*, 31.3.38, **36** (46), 125.—The work was carried out with stabilized gasoline containing no H_2S. Analyses were carried out on doctor solutions before and after use, and sulphur in gasoline before and after treatment was determined in terms of elementary, mercaptan and "residual" sulphur. Recovery of used doctor solution was effected in agitators of the turbo-mixer type, sucking air into the system and converting sulphide into plumbite:

(1) $PbS + 2O_2 \longrightarrow PbSO_4$; (2) $PbSO_4 + 4NaOH \longrightarrow Na_2PbO_2 + Na_2SO_4 + 2H_2O$.

After about nine or ten recoveries the dissolved lead–oxide content of the recovered solution dropped, doubtless due in part to building up sodium sulphate in reaction (2), causing the reaction to be reversed, lead sulphate being insoluble. After the next treatment the lead oxide content was entirely used up and sodium mercaptide formed, rendering the batch unsuitable for further recovery. If dissolved lead is exhausted, mercaptans will be liberated during the recovery operation, the reaction (3) $RSH + NaOH \rightleftharpoons NaRS + H_2O$ being reversible. It has been found that if doctor solution is recovered while it still has a trace of dissolved lead by qualitative test, no odour nuisance exists even when treating gasolines of high mercaptan sulphur content.

Experiments showed that in three tests an average of only about 48% and 46%, respectively, of the theoretical quantities of litharge and added sulphur required, when based on generally accepted mechanism of the doctor treatment, was actually used. It was concluded that direct oxidation of mercaptan by means of sulphur and oxygen with the aid of lead sulphide as catalyst was also taking place, and various possible reactions are illustrated. By impregnating a porous material with an aqueous solution of lead acetate, drying and converting into lead sulphide by passage of H_2S, the effect of using sulphur and oxygen each separately in solution in the gasoline, as well as together, was studied. No sweetening took place with sour gasoline only, or when sulphur only was added. With addition of oxygen, the gasoline was sweetened for about 3 hrs. running time. Then, by introduction of sulphur as well, the same type of catalyst continued to sweeten for over 100 hrs. without signs of losing activity. Furthermore, no decrease in the maximum sweetening rate occurred.

The following mechanism of reaction is suggested: (4) $PbS + 2O_2 \longrightarrow PbSO_4$; (5) $PbSO_4 + 2RSH \longrightarrow Pb(SR)_2 + H_2SO_4$; (6) $Pb(SR)_2 + S \longrightarrow PbS + R_2S_2$: sulphate and sulphide have been found present in the used catalyst, but no acidity has been detected. Experiments with lead oxide and sulphate mixed with the carrier were also successful, apart from mechanical difficulties, and the presence of lead sulphide established after a time. The advantages of dry sweetening are: (1) automatic recovery with no possibility of odour nuisance, (2) no loss of naphtha by emulsion with caustic, (3) no aqueous solutions to manipulate in cold weather. On the pilot plant scale at rates of 10 brls. per hour using lead acetate impregnated on 16 × 30-

mesh bone-black, the treated naphtha became positive after 94 hrs. recovering, but this was found to be due to deposition of gummy material on the catalyst. Reasonable restoration was effected by washing with solvent. Analysis of the gum indicates that disulphides and polysulphides were extracted by the bone-black, and that the gum so found prevented proper contact between gasoline and catalyst. Dry sweetening is therefore quite feasible, but further research on plant operation is required.

R. A. E.

720. Special Type of Combination Cracking and Skimming Unit. R. P. Mase. *Oil Gas J.*, 31.3.38, **36** (46), 101.—A combination cracking and skimming unit has recently been installed by Panhandle Refinery Co. at Lueders, Texas. The plant was designed for a crude skimming capacity of 1000 brls. a day and a topped crude cracking capacity of 500 brls. a day. Skimming is effected entirely by heat exchange with (*a*) skimming plant gasoline vapours, (*b*) side-stream from cracking-plant fractionator, (*c*) oil from the base of cracking-plant fractionator. Yields of 30·7% gasoline of 400° F. E.P., 12·2% kerosine and 4·5% gas oil are obtained. Hot topped crude is pumped from the bubble tower direct to the cracking plant. With a view to economy in construction and operating costs, and to give satisfactory yields of finished products, departures from normal practice were made. It was decided to use two-coil selective cracking to produce high-octane motor fuel. Both coils are installed in one furnace of the upshot type. The combustion chamber is split into two compartments to give separate control on the heavy and light oil coils. Light furnace feed is taken from an intermediate well in the cracking-plant fractionator. The unit is brought on stream with oil, but in operation is fired with process gas. Other plant and operating details are given. One operator per shift handles the entire unit. The yield of cracked gasoline of 71 octane number is 52·7% based on the topped crude or 26·1% on the crude. The cracked residuum of 7/8° A.P.I. grav. is better than Bunker C specification. The cracked gasoline is sweetened and inhibited. The straight-run gasoline is sweetened and marketed as third grade or turned into Q Ethyl. R. A. E.

721. Double-End-Fired Naphtha and Gasoline Reforming Furnace. Anon. *Industr. Engng Chem.*, 1938, **30** (4), 398.—A short description with sketches and photographs of a 10,500 brls. per day reforming plant is given. The more important modern features of furnaces of this type are emphasized. J. W. H.

722. Simplified Automatic Combustion Control for the Refinery. W. F. Schaphorst. *Petrol. Engr*, Feb. 1938, **9** (5), 77.—A description with sketches is given of a simple method for automatically regulating valves, dampers, fans, etc., on boilers to maintain constant pressure. The regulator virtually "weighs" the steam pressure in the boiler, and the plunger automatically adjusts the damper and gas fuel-control valve, the latter by a weighted lever valve. A similar arrangement can be used for controlling the flow of oil and the steam atomizing control valves for high- or low-pressure oil-fired boilers. C. L. G.

723. Boiler Feed-Water Treatment at a High-Pressure Station. S. T. Powell, I. G. McChesney and F. Henry. *Industr. Engng Chem.*, 1938, **30** (4), 400.—The Rochester Gas and Electric Corporation's power-station extension which serves an extensive territory along the shores of Lake Ontario utilizes 700-lb. boilers and turbines which are superimposed on an existing low-pressure station. The exhaust steam from the new boiler equipment is used in the older low-pressure turbines and is only partly recoverable as condensate. The high-pressure boilers consequently require a high percentage of make up.

The source of boiler feed-water is a river supply which fluctuates widely in mineral content and turbidity, and at times is seriously contaminated with sewage. This water presents a difficult problem when used in high-pressure boilers. During the course of several years a method of treating this water has been evolved whereby the raw water is considerably softened. The water is softened, settled and filtered in the old intermittent lime–soda equipment, and then softened again in a modern hot process softener utilizing phosphates only. The problem of phosphate deposition in the feed-water system was overcome by lowering the *p*H value with acid, using

recording *p*H controlling equipment. The new 700-pound boilers are equipped with steam washers and the quality of the steam is followed by measuring the conductivity of a condensed sample by means of a continuous-flow conductivity recording meter.
H. E. T.

724. Tube Failures in Refinery Stills. E. C. Wright and H. Habart. *Nat. Petrol. News*, 23.3.38, **30** (12), R. 126.—The general conclusions resulting from the laboratory investigation of some hundreds of tube failures over a period of 20 years are presented. Improvements in steel and furnace design have resulted in very considerable increases in the service life of tubes. Low creep strength is responsible in cases where the breakdown is caused by the bursting of the pipe. Alloy steels containing 1–5% Cr sometimes fail from intercrystalline corrosion owing to oxidation or corrosion of grain boundaries. This type of failure is rare with ferritic type steels. 18–8 alloy has proved to be singularly resistant to both oxidation and corrosion, but under certain conditions of structure, stress and temperature failures have occurred from intercrystalline oxidation and corrosion.
H. G.

725. Packing Materials. Study in a 5·1-cm. Fractionating Column. M. R. Fenske, S. Lawroski and C. O. Tongberg. *Industr. Engng Chem.*, 1938, **30** (3), 297.—Seventeen forms of packing were tested in a column 5·1 cm. diameter 2·59 metres high, using *n*-heptane–methyl *cyclo*hexane mixtures. The results are given in full, and cover a vapour-velocity in most cases of 8–40 cm. per sec. approximately. The effect of velocity on efficiency was not pronounced. The number of plates was found to depend on the state of wetting of the packing, flooding of the packing before a test giving a more efficient column. The following packings were tested, and typical values of the H.E.T.P. are also given.

(1) Open column	65 cm.
(2) ½-in. carbon Raschig rings	19 cm.
(3) ½-in. stoneware „	17 cm.
(4) ⅜-in. stoneware „	16 cm.
(5) ½-in. carbon „	13 cm.
(6) ¼-in. glass „	14 cm.
(7) No. 19 aluminium jack chain	10·5–16·5 cm.
(8) ½-in. clay Berl saddles	17 cm.
(9) ½-in. aluminium „	11·5–14 cm.
(10) 6 mesh carborundum	4·5 cm.
(11) ¼-in. i.d. aluminium single turn helices	15 cm.
(12) $\frac{3}{16}$-in. „ „	12·5 cm.
(13) $\frac{5}{32}$-in. „ „	11 cm.
(14) $\frac{5}{32}$-in. nickel „	10 cm.
(15) ⅛-in. „ „	6·5–10·5 cm.
(16) $\frac{3}{32}$-in. stainless steel „	5·5 cm.
(17) $\frac{1}{8} \times \frac{7}{32}$-in. carding teeth	5–9 cm.

The wire packings were more subject to the effects of wetting than the others.

The limiting velocities were measured in some cases, and were as follows:

Packing No. 4	33·5 cm. per sec.
Packing No. 7	50·5 cm. per sec.
Packing No. 10	10 cm. per sec.
Packing No. 11	64 cm. per sec.

Pressure drop down the column was measured in all cases.
P. D.

Chemistry and Physics of Petroleum.

726. Mechanism of Polymerization. Part 2. Dimerization of Dimethylbutadiene in Presence of an Acid Catalyst. E. H. Farmer and R. C. Pitkethly. *J. chem. Soc.*, 1938, 11–19.—The polymerization of $\beta\gamma$-dimethylbutadiene by sulphuric acid dissolved in acetic acid gives dimeric, trimeric and other low molecular products, but the nature of the product varies somewhat with the experimental conditions.

The dimeric product consists mainly of a monocyclic (*cyclo*hexenic) hydrocarbon. Under other conditions, dicyclicdimeride is also formed.

The *cyclo*hexenic dimeride is identical with that which has frequently been obtained by the action of heat on $\beta\gamma$-dimethylbutadiene, and the authors have synthesized this dimeride. W. E. J. B.

727. Hydration of Acetylenes. Part 11. Penta-2-yne. E. L. R. Mowat and J. C. Smith. *J. chem. Soc.*, 1938, 19–22.—The hydration of penta-2-yne with 80% sulphuric acid has been studied by estimation of the amounts of methylpropyl and of diethyl ketone produced. The results along with those of the hydration of Δ^9-undecynoic acid show that in the reaction $2CH_3{\cdot}C{\equiv}CR + 2H_2O \longrightarrow CH_3{\cdot}CH_2{\cdot}COR + CH_3{\cdot}CO{\cdot}CH_2R$ the acetylenes display increasing reactivity with increasing length of alkyl chain. W. E. J. B.

728. Vapour Phase Reactions of *cyclo*Propane with Iodine and Bromine. R. A. Ogg and W. J. Priest. *J. Amer. chem. Soc.*, 1938, **60**, 217–218.—On heating a mixture of *cyclo*propane at about 300 mm. pressure and iodine vapour at about 100 mm. in sealed Pyrex glass bulbs at 250° C., 1 : 3-di-iodopropane is the main product formed. An association reaction of iodine molecules appears as the most probable reaction mechanism.

A rapid photo-reaction of *cyclo*propane and bromine vapour occurs at room temperature when illuminated by intense visible light. The principal product is 1 : 3-dibromopropane. W. E. J. B.

729. Thermal Decomposition of Hexane at High Pressures. J. N. Pearce and J. W. Newsome. *Industr. Engng Chem.*, 1938, **30** (5), 588.—The thermal decomposition of hexane has been investigated over the temperature range 430–520° C. for 10° intervals and at pressures of 1400–1500 lb. per square inch. The time of an experiment varied from 2 mins. to 2 hrs. In all cases the thermal decomposition of the hexane under these high pressures resulted in the formation of compounds having boiling points both above and below that of hexane; in some cases carbon formation was evident. The gaseous reaction products boiling below 100° C. are chiefly paraffinic in nature, whereas those boiling above 100° C. contain predominating quantities of *cyclo*paraffins with appreciable amounts of aromatics, and some olefines. The hexane used in this work was prepared from a petroleum spirit by treatment with strong sulphuric acid and subsequent fractionation; the final material had b. pt. 67–68° C. at 747 mm. and n_D^{20} 1·3828. The actual experiments were of the "static" nature and were carried out in a molybdenum-steel bomb of 148 c.c. capacity, of cylindrical shape, with a 3-cm. bore and a wall thickness of 4 cm. H. E. T.

730. Mixed Polymerization of Butenes by Solid Phosphoric Acid Catalyst. V. N. Ipatieff and R. E. Schaad. *Industr. Engng Chem.*, 1938, **30** (5), 596.—Catalytic polymerization of *iso*butene, normal butenes and mixtures of *iso*butene and normal butenes by means of a solid phosphoric acid catalyst, under 7–8 atms. pressure and at 95–100°, 177° and 120° C., respectively, resulted in the formation of polymers containing 70, 55 and 74–80%, respectively, of octenes. These octenes on hydrogenation yielded octanes of 98–100, 83–85 and 95–97 octane number, respectively. Polymerization of mixtures of *iso*butene and *n*-butene at 42 atms. pressure and at 149° C. resulted in formation of polymers containing 88% by vol. of octenes, which on hydrogenation yielded octane of 95 octane number. For the production of mixed octanes of high-antiknock value, polymerization of *iso*- and *n*-butene mixtures was found to be superior to mixing the polymers formed separately from each of these butenes. Thus octane derived from 50% of *iso*butene and 50% *n*-butenes by mixed polymerization and subsequent hydrogenation had an average octane number of 3·5 points higher than that of an octane blend composed of 50% hydrogenated di-*n*-butene and 50% hydrogenated di*iso*butene (*iso*-octane). H. E. T.

731. Gas–Liquid Equilibria for the System Methane–Butane. G. W. Nederbragt. *Industr. Engng Chem.*, 1938, **30** (5), 587.—A study has been made of the composition

of both the gas and liquid phases in the case of mixtures of methane and *n*-butane. The methane employed contained 1·1% of ethane as impurity, whilst the butane consisted of 96·6% *n*-butane and 3·4% *iso*butane. The gas samples were analysed by selective absorption in toluene, and the liquid samples by the low-temperature Podbielniak apparatus. Determinations were carried out at the temperatures − 20°, 15° and 40° C., and at three pressures 10, 20 and 30 atms. H. E. T.

732. Thermal Decomposition of *n*-Octane. R. T. Marschner. *Industr. Engng Chem.*, 1938, **30** (5), 554.—The *n*-octane used in this work was isolated from a mid-continent naphtha, by distillation and subsequent crystallization of a fraction boiling from 120 to 130° C. The final *n*-octane had b. pt. 126 ± 0·5° C. and n_D^{20} 1·3990 and was considered to be approximately 95–98% pure. The thermal decomposition of this *n*-octane has been studied at 57° C. and atmospheric pressure in both steel and pyrex glass apparatus. A long but simple series of products was obtained, which differed quantitatively from those predicted by the free radicle theory in the quantities of ethylene and the higher olefines which were produced. When the thermal decomposition of *n*-octane was carried out in pyrex glass, the product analyses were approximately the same when decomposition was increased from 18 to 33%, and they differed but little from those obtained at 538° C. This deficiency of ethylene is not readily explained, but the variation in the higher olefine content of the products can be accounted for by the assumption that the octyl radicles rupture unequally in the two possible theoretical directions. At temperatures below 571° C., stainless steel apparatus which had been in use for an extended period gave products containing abnormal amounts of methane, the other products not being greatly changed. Above 571° C. both methane and hydrogen were formed with the exclusion of the heavier products of pyrolysis. Fractionation and chemical treatment of the liquid products of decomposition indicated that the saturated hydrocarbons retained the linear structure of *n*-octane, as assumed by the free-radicle theory, but that the 1-alkenes which were apparently produced first in the pyrolysis were accompanied by small amounts of other unbranched alkenes and *cyclo*alkenes. H. E. T.

733. Catalytic Water Gas Reaction. Mass Transfer and Catalyst Activity. F. G. Laupichler. *Industr. Engng Chem.*, 1938, **30** (5), 578.—Equations have been derived for the mass transfer and reaction velocity of the catalytic water-gas reaction at constant reaction temperature for any given amount of catalyst by expressing in absolute units the activity of the catalyst. In these relations the effect of mass transfer has been separated from the catalytic effect. A method of approximation is given enabling the equations to be applied when the conversion proceeds at a steadily increasing temperature. The validity of the theory developed is demonstrated by a detailed analysis of experimental tests on a commercial plant. It is concluded that in industrial practice diffusion resistance is negligible compared with chemical resistance, and hence mass transfer will generally play a minor rôle. J. W. H.

734. Viscosity and Chemical Constitution. M. Souders. *J. Amer. chem. Soc.*, 1938, **60**, 154–158.—The author has plotted the double logarithm of the viscosity (in millipoises) at constant pressure against the density in gms. per c.c., and found that a substantially straight line is obtained for each compound. The curvature of the line usually increases in the vicinity of the melting point or boiling point, but over the intermediate range the function is nearly linear.

Although the slopes of the lines obtained vary widely, the intercepts obtained on the viscosity axis are nearly equal, so that an average value of − 2·9 may be used for all organic liquids. Thus a general equation relating viscosity and density is obtained—namely, $\log_{10}(\log_{10}\eta) = md - 2{\cdot}9$; the constant m is characteristic of each liquid and is substantially constant, but water and phenol are exceptions. The values of m for all the paraffin hydrocarbons examined are nearly equal, and a relationship is suggested—namely, $mM = I$, in which m is the viscosity density constant, M is the molecular weight and I is the viscosity constitutional constant. The value of I calculated by the equations determined from the experimental data should agree with the calculated value obtained from the summation of general atomic and struc-

tural constants. Based on data for 117 different organic liquids, a comparison between the observed and calculated values of I indicates in nearly all cases errors of less than 1%. W. E. J. B.

735. Viscosity of Oil-Water Emulsions. G. Broughton and L. Squires. *J. phys. Chem.*, 1938, **42**, 253.—Emulsions of benzene, Nujol and olive oil in water were prepared using sodium oleate, saponin and triethanolamine oleate as stabilizers. All the oils were weighted with α_1-bromonaphthalene to give a specific gravity of 1·00. The viscosities were determined by MacMichael viscometer, and are given in form of yield point, limiting viscosity and relative limiting viscosity.

The equation of Hatschek as modified by Sibru does not express the relation between relative limiting viscosity and volume concentration of disperse phase, but a logarithmic equation is more successful. P. D.

736. Freezing Points of Pure Hydrocarbons. J. Smittenberg, H. Hoog and R. A. Henkes. *J. Amer. chem. Soc.*, 1938, **60**, 17–22.—Freezing-point determinations have been made on a number of carefully purified hydrocarbons with boiling points within the gasoline boiling range. All the normal paraffins examined crystallized readily and showed only slight under-cooling, or none at all. Some *iso*paraffins showed considerable under-cooling, and those possessing an asymmetrical carbon atom could not be crystallized, and solidified to a glass—*e.g.*, 2 : 3-dimethylpentane, 3-methylheptane, 2 : 3-dimethylhexane, etc. All the naphthenes and aromatics examined could be crystallized, and transition points were observed with *cyclo*pentane and *cyclo*hexane.

The freezing-point diagrams of some binary mixtures were observed, and in general there is a eutectic point, and freezing-point curves of the components conform to the formula for the ideal freezing-point curve. Most of the binary *iso*paraffin mixtures produced glass formation. W. E. J. B.

737. Influence of Gaseous Discharge on Hydrocarbon Oils. L. J. Berberich. *Industr. Engng Chem.*, 1938, **30** (3), 280.—A review of the literature dealing with the effects of discharge on mineral oils and on pure hydrocarbons is given. Experiments made by the author are described. The apparatus consisted of a glass ozonizer, using 60-cycle current. The oil to be tested was fed into the ozonizer under vacuum (2 mm. of mercury) and air removed at 80° C. A final vacuum of 0·05 mm. was reached, and after disconnecting the vacuum pump the 60-cycle voltage is applied. The oil is not circulated, but foams vigorously under the action of the discharge. The rate of evolution of gas was observed from the increase in pressure. Gas could be removed for analysis by Toepler pump if desired. A voltage of about 13,000, and an oil charge of 30 c.c. were used.

The effects of refining and the addition of cable paper were studied. Refining (either solvent or sulphuric-acid treatment) increases the gas evolution, as does the addition of dried and powdered cable paper. Solvent extracts show a very small gas evolution, and the effect of blending extract and a highly refined oil were studied. The gases evolved in these experiments were 80–90% hydrogen, and 10–20% combustible hydrocarbons.

The effect of a series of addition agents on the gas evolution was also studied. In the first tests dibenzyl disulphide was used, and it was shown that this material was hydrogenated. Other compounds of the aromatic type were found to be effective. The effect was greatest with compounds of high vapour pressure and oils of low viscosity. Lowering of the gas evolution is accompanied by production of solid polymer products. P. D.

738. Compressibilities of Butane–Pentane Mixtures below one Atmosphere. F. W. Jessen and J. H. Lightfoot. *Industr. Engng Chem.*, 1938, **30** (3), 312.—The compressibilities of propane at 0° and 50° C., and of *iso*butane at 0° and 30° C. have been determined. The compressibilities of pentane and *n*-butane–*n*-pentane gas mixtures have been determined at 30° C. It is found that the compressibility of a mixture of gases at low pressures can be determined from those of the components by the additive rule. P. D.

739. Measurement of Flame Speeds. E. F. Fiock and C. F. Marvin. *Chem. Rev.*, 1937, **21** (3), 367.—This article deals with the measurement of flame speeds when an explosive mixture of gases is ignited by a spark. Under such conditions the flame spreads in all directions from the point of ignition; and the observed spatial velocity of the flame front in any direction is always the resultant of two component velocities: (*a*) the speed of propagation relative to the unburned gases, and (*b*) the speed at which the flame front is transported bodily in a direction normal to its surface by mass movement of the gases compressing it. The first component (*a*) or speed at which the reaction zone advances into and transforms the unburned charge, is a characteristic property of the explosion mixture, and this property is termed the "transformation velocity." The second component (*b*) or "gas velocity" is only of minor practical and theoretical interest.

In this report, both "constant pressure" and "constant volume" methods involving spherical flames in the absence of detonation, for the measurement of transformation velocities, are discussed at some length. To be of the greatest practical utility a method for measuring flame speed must yield transformation velocities, and of the various methods which have been used those employing spherical flames appear to be susceptible of the most rigorous analysis. In both constant-pressure and constant-volume methods adequate control of the composition of the gas mixtures must be provided and all components must be gases or vapours; further, the light emitted by the explosions must be sufficiently actinic for photographic purposes. Flame speeds must not be so great that excessive pressure gradients are developed ahead of the flame front, or so small that convective rise is apparent during the explosion. In addition, both methods have their own special advantages and limitations.

The constant-pressure bubble method has the great advantage that it requires the measurement neither of rapidly changing pressure nor of gas flow, and all results are obtained from a photographic record of the flame spread. Under favourable conditions the various properties of flame motion may be evaluated by the bubble method with a precision which is probably unattainable by any other method. The principal disadvantage of the bubble method is that the partial pressure of water vapour in the explosion mixture is fixed by the temperature and composition of the soap film. This limitation is serious when water is involved in the combustion reactions, and, in addition, the material of the soap film must not react chemically or dissolve any constituent of the explosion mixture, and thus cause a variation in its composition.

The spherical bomb of constant volume is adapted to the measurement of flame speeds over much wider ranges of charge composition, pressure, and temperature than is possible in the constant pressure bubble method, and further charge composition may be varied at will, provided the constituents are gases or vapours. Conditions in the spherical bomb may also be made to approximate to those prevailing in an engine, but greater opportunity exists for independent variation and control of conditions. The mechanism of an explosion at constant volume is more complex than that at constant pressure, a more complicated apparatus and experimental technique is required and the results obtained are more prone to error. H. E. T.

740. Flame Temperatures and Vertical Gradients in Natural-Gas Flames. H. H. Kaveler and B. Lewis. *Chem. Rev.*, 1937, **21** (3), 421.—The experiments described in this paper were carried out in order to obtain information on the state of the burnt gas that emerges from a flame by comparing observed maximum flame temperature determined by sodium line-reversal method with calculated theoretical temperatures, and by careful investigation of the nature of the temperature gradient in the vertical direction above the cones of suitably constructed stationary flames. The natural gas used in these experiments had the following analysis: methane 85·48%, ethane 13·85%, nitrogen 0·67%. For mixtures of air and natural gas (Pittsburgh) the vertical temperature gradient above the cones is positive, the temperature range and length of positive gradient depending on space velocity and mixture composition. In natural gas–oxygen mixtures the maximum temperature is found immediately above the cones, and the vertical temperature gradient is uniform and negative for several centimetres above the cone. The maximum observed temperatures in natural gas–air mixtures show the maximum deviation from the theoretical near the stoichiometric point, being about 20–40° C. lower; whereas for natural gas–oxygen mixtures the average temperature slightly exceeded the theoretical value. The results are explained on the basis of heat loses, and the excitation lag in oxygen mixtures. H. E. T.

741. Problems in Flame Propagation. H. F. Coward and W. Payman. *Chem. Rev.*, 1937, **21** (3), 359—A short account is given of the outstanding problems in flame propagation, and the authors suggest that the fundamental problem is to ascertain the mechanism by which flame travels through an inflammable gas mixture, *i.e.*, to correlate the speed of movement of flame with the various chemical and physical factors involved by means of an equation with no empirical constant. Only the more usual mode of flame propagation is considered—namely, that in which the pressure of the gas in the flame is not sensibly greater than that of the rest of the gas. Some of the outstanding experimental observations that must guide future theoretical developments are discussed. H. E. T.

742. Dephlegmator Efficiency. Typical Data and Graphical Calculation. H. A. Webber and G. L. Bridger. *Industr. Engng Chem.*, 1938, **30** (3), 315.—The theoretical value of a partial condenser as a fractionating device varies widely depending on whether simple or differential condensation is presumed to take place. The former gives one theoretical plate, and the latter several plates depending on the conditions. The calculation in the latter case may be made using Lewis' equation (*Ind. Eng. Chem.*, 1909, **1**, 522). The actual value obtained in practice is a matter of considerable controversy.

The authors consider the data necessary to determine the efficiency of the condensers in a practical test, and decide that the results should be expressed in terms of equivalent theoretical plates as suggested by Underwood. The results of a series of runs on a 10-plate column using various binary mixtures are analysed graphically, and it is shown that the partial condenser is equivalent to approximately half a theoretical plate. P. D.

743. Vapour Pressure of Solvents. D. H. Killeffer. *Industr. Engng Chem.*, 1938, **30** (4), 477.—Two nomographs are given showing the relationship between temperature and vapour pressure over the range 1–1000 mm. pressure for 35 solvents of boiling point below 90° C. and 34 solvents of boiling point between 90 and 150° C. J. W. H.

Analysis and Testing.

744. Permissible Methane Detectors. L. C. Ilsley and A. B. Hooker. *Bur. Mines Reports Investigation* 3359, Dec. 1937.—Bureau of Mines RI. 331, 1930 described permissible methane detectors of four different types—*e.g.*, flame, combustion, catalytic and a combination Wheatstone bridge and catalytic type in which catalytic action at the surface of a platinum filament when in methane causes a change in the temperature and resistance of the filament, thus unbalancing the bridge circuit and giving a reading proportional to the methane concentration. The present report describes three detectors of the last-mentioned type which have been approved since 1930. These are: (1) the U.C.C. indicating detector, which was described in the previous bulletin and has now been modified to permit the checking of the calibration of the detector at any time, whether in gas or fresh air; (2) the M.S.A. Type AP-6 Detector; (3) the M.S.A. Type AP-5 Detector Dry Cell type, which differs from the previous type in not containing any lighting attachment and has a battery of the two No. 6 dry cells inside the detectors housing, and (4) the M.S.A. Type W. 8 Detector, which is a further modification, in that both filaments, detector and compensator are in the gas-flow circuit, and thus subjected to the same gas mixture. The filaments are electrically connected in series across the whole battery. Other improvements include a provision for quickly checking the calibration at any time, the elimination of the expansion chamber and dryer, and an appreciable decrease in the size and weight of the detector.

The importance of proper maintenance of the detectors and the advisability of checking the setting before each methane determination (which is possible in the case of the U.C.C. and M.S.A. Type W. 8 detectors) are stressed. C. L. G.

745. Sulphuric Acid Extraction Methods for Determining Olefins and Aromatics in Hydrocarbon Oils. Optimum Conditions and Concentrations of Acid. C. H. Fisher and A. Eisner. *Bur. Mines Reports Investigation* 3356, Dec. 1937.—80% H_2SO_4 dissolves or polymerizes reactive olefins, but fails with the more reactive olefins—*e.g.*, diamylene, cetene, etc. Stronger H_2SO_4 is more effective and is suitable for oils of low aromatic content, but tends to attack aromatics and to catalyse their reaction with olefins. For highly aromatic—*e.g.*, coal tar—oils 80–82% H_2SO_4 should be used. The addition of, *e.g.*, silver sulphate or boric acid to the H_2SO_4 increases the effectiveness of olefin extraction, but leads to undesirable side reactions—*e.g.*, condensation of aromatic and olefin hydrocarbons. H_2SO_4 of up to 84% concentration causes only negligible sulphonation of aromatics, but even that of 82% concentration caused alkylation of the aromatics. Kattwinkel's olefin reagent (concentrated H_2SO_4 containing boric acid) attacks olefins vigorously, but also sulphonates aromatics. For the sulphonation of aromatics, concentrated H_2SO_4 is effective, although benzene and certain benzene derivatives containing large and bulky alkyl substituents offered resistance to sulphonation. Higher concentrations than 98% and Kattwinkel's reagent are not advisable, as they remove considerable amounts of saturated hydrocarbons. The addition of silver sulphate is not necessary and not very advantageous. The use of two washings with 3 vols. of 98% acid or one wash with 96% acid followed by treatment with 98% acid is recommended, as this removes all aromatics without attacking more than traces of saturated hydrocarbons.

In an examination of two synthetic hydrocarbon solutions of the various methods tried, that of Kester and Pohle (*Industr. Engng Chem. Anal.*, 1931 (3), 294–297) was found to give the most accurate results. In this olefins were determined with 80% H_2SO_4. C. L. G.

746. Report of the International Commission for the Study of Fatty Substances. Anon. *Olii min.*, 1937, **16** (12).—This article reports the proceedings of the 8th Conference held at Paris in October 1937. The programme of work for the year 1937–1938 is outlined.

Details are given of the methods of determining titre, unsaponifiables, water content, total alkalinity, etc. W. E. J. B.

Motor Fuels.

747. Improving Gasoline by Caustic Washing. C. M. Ridgeway. *Oil Gas J.*, 31.3.38, **36** (46), 83.—An increase in the mercaptan sulphur content of the gasoline at a certain refinery accompanied by increase in T.E.L. requirement for a given octane number prompted a survey of literature on the subject and an investigation of the problem. Tables prepared from the literature survey show the influence of various sulphur compounds on octane number and T.E.L. requirement, their physical properties and data on solubility in caustic solution, factors affecting extraction efficiency by caustic solution such as effect of caustic concentration and volume, types of compounds in the gasoline, etc.

In the present work the gasoline used was a Michigan combination high-pressure gasoline. The influence of volume of wash on mercaptan removal and value of K in the equilibrium equation, K = concentration of mercaptan in caustic phase divided by the concentration of mercaptan in the gasoline phase, was determined. It was found that plotting the log of the volume of wash against the reciprocal of K gave a straight-line relationship, thus permitting extrapolation. From this data curves were plotted showing the influence of caustic strength and volume on mercaptan sulphur removal. By the use of a single wash with fresh caustic it was difficult to reduce the mercaptan sulphur content of the gasoline below 0·016% wt., consequently the effect of multiple washing was examined using 20% by vol. of 11% fresh caustic for each wash. An analysis of the data showed that about twelve washes would be required to reduce the mercaptan sulphur from the original 0·05% wt. to 0·005% wt. which was the reduction aimed at. The influence of concentration of mercaptan sulphur in the caustic on mercaptan sulphur content of the washed gasoline was then examined by washing twenty successive batches of gasoline with 20% by volume of a 16° Bé. solution of caustic. The results are tabulated together with calculated

exhaustion, washing efficiency factors, etc. With aid of charts prepared from the data it is possible to determine with reasonable accuracy the limits of caustic exhaustion which can be used in the plant, and to a certain extent predict the number of stages required to remove a given amount of mercaptan.

Since the extent of mercaptan removal and the effect on T.E.L. requirement vary for different gasolines according to the type of the mercaptan present and the nature of the fuel, the economic advantage of caustic washing must be determined for each individual gasoline. Examples of effect of mercaptan sulphur on T.E.L. requirements obtained during the present examination and by Birch and Stansfield on gasolines of various types and origins are given. Experience shows that a closed continuous counter-current system of washing should be used, as batch operations involve loss of light ends, introducing a serious error when comparing T.E.L. responses of the treated gasolines. R. A. E.

748. Aircraft Fuels of High Octane Rating. W. H. Hubner and G. Egloff. *Oil Gas J.*, 31.3.38, **36** (46), 103.—From 1932 to 1938 the total consumption of aviation gasoline has increased from 54 million to about 98 million gals. The average octane number used by the U.S. Army Air Corps has risen from 82 to about 98 (Air Corps method), and by commercial airline from 73 to about 89 (C.F.R. motor method). In 1938 it is estimated that 90% of the Army Air Corps requirements will be taken in the form of 100 octane fuel, and that in all about 20 million gals. of 100 octane fuel will be used. The savings to be effected by the use of 100 octane fuel in place of 87 octane fuel based on the estimates of various experts are discussed. *iso*-Octane and to a limited extent *iso*pentane are the only high-octane blending agents with extensive service history. Others which have been suggested as commercially useful are: aromatics, ethers (*iso*propyl), ketones and alcohols. Comparative octane values and physical properties of all these blending agents are tabulated, and the merits or defects, production methods and potential supplies available of each agent are discussed. Under certain conditions it has been found more economical to produce *iso*-octanes of 90–95 octane rating, by utilization of *n*-butylene as well as *iso*butylene for hydrogenation, instead of 100 octane rating. The lower octane rating *iso*-octanes are as stable as the 100 octane rating product, and lead susceptibilities are high. Tables show the effect of 90, 95 and 100 octane rating products as blending agents for various straight-run gasolines when used in conjunction with 3 mls. T.E.L. per gal. Other tables show the blending values C.F.R. motor method and Army method of all the proposed high-octane blending agents with and without additions of T.E.L. Although T.E.L. is the only anti-knock compound in general service for aircraft fuels, it has certain limitations in respect of hot and cold corrosion, deposition on sparking-plugs, decreasing efficiency with increasing concentration. These matters are discussed.

Recently a patented mixture marketed by Fuel Development Corporation and consisting of a mixture of aniline and alcohol (butyl and either ethyl or methyl) has come into limited use. Partly because of its poor solubility in gasoline, it is ordinarily introduced into the fuel system through a metering injection device, in which case it is used both as a de-icing fluid and as an anti-knock for take-off or during emergency operation of a multi-engine aircraft when one engine is inoperative. Its present cost is about $3 per gal. Its effectiveness is compared with those of aniline and ethyl alcohol with and without additions of T.E.L. in 70 and 87 octane base fuels.

The use of water as a take-off anti-knock agent when injected into the intake manifold of the engine is discussed. Mixtures of alcohol and water for the same purpose would avoid freezing and also have possibilities as a de-icing fluid. Test methods for determining octane ratings by C.F.R. motor method, U.S. Army Air Corps, and the modified motor method employed by the British Air Ministry are described, and tables given to show comparative results on various types of high-octane blending agents, in blends with 70 octane straight-run fuel, with and without additions of T.E.L. It is hoped that tests now being carried out in U.S.A. and in Europe will result in a universal method of test being adopted. When this is accomplished, it is expected that the number of specifications in force (at present 14 in U.S.A. and 11 in other countries) for aircraft fuels will be reduced. The ten specifications for 87 octane grade at present in use in U.S.A. are tabulated, and show considerable variations in volatility requirements. It is suggested that uniformity in this respect should be given consideration. R. A. E.

749. Study of *iso*Propyl Ether as a Motor Fuel. A. Sokolik and A. Voinov. *Technical Physics of the U.S.S.R.*, 1937, **4** (8), 638–660.—The authors describe the results of their investigations into the effects of engine speed and operating temperature on the anti-knock properties of straight-run and cracked gasoline and mixtures of these with ethyl fluid, *iso*-octane, benzol and di*iso*propyl ether. A C.F.R. engine was used together with a photographic apparatus for recording flame propagation in the cylinder. Numerous tests were carried out at widely varying temperatures of both mixture and cooling liquid, whilst recordings were taken at engine speeds of 700 and 1100 r.p.m.

By determining the maximum degree of ignition advance which a particular fuel would stand without detonating, it was found that increased preheating of the mixture caused rapid depreciation of the anti-knock properties of cracked gasoline, benzol, and also pure *iso*-octane, although blends of the latter with straight-run gasoline were little affected by increase of mixture temperature, and in this respect behaved similarly to ordinary gasoline. Leaded gasoline showed relatively low depreciation of anti-knock properties with increasing temperature, whilst blends of gasoline with more than 50% *iso*propyl ether showed remarkable freedom from detonation at mixture temperatures up to as high as 200° C.; the surprising phenomenon was observed that the tendency of *iso*propyl ether to detonate diminished with a *decrease* in r.p.m.

The authors' conclusions support the necessity for a complete revision of the present accepted methods of determining octane ratings of motor fuels, which they contend should be carried out at various carburettor and jacket temperatures, and also at varying speeds of the test engine; the results thus obtained should facilitate selection of the most suitable fuel for the particular conditions under which it would be used in practice. A. R. O.

750. Spontaneous Ignition Under Pressure of Typical Knocking and Anti-Knocking Fuels. M. Maccormac and D. T. A. Townend. *J. chem. Soc.*, 1938, 238–246.—Previous investigations have been extended to include observations with some of the newer non-knocking fuels, notably *iso*-octane, di*iso*propyl ether and acetone.

It is found that much higher pressures are necessary for the spontaneous ignition of side-chain paraffins than for the straight-chain isomers, but the temperature ranges in which cool flames are observed, and the character of the low-temperature ignition systems induced thereby, are much the same in both cases.

The cool flame zones on the lower ignition systems of the ethers appear to be composite, and much higher pressures are required for the ignition of mixtures of air with di*iso*propyl ether than for those with diethyl ether.

The authors present most of the results graphically, and suggest a scheme whereby the relative knock-rating of a fuel may be assessed from the characteristics of its spontaneous ignition under pressure. W. E. J. B.

751. Italian Proposed Specifications for Mineral Oils. Anon. *Olii min.*, 1937, **16** (12), 133–134.—Specifications for the following products are listed: Aviation and motor spirit, illuminating kerosine and power kerosine, gas oil, diesel oil, fuel oil. Three grades of bitumens. W. E. J. B.

752. Patents on Motor Spirit. N.V. de Bataafsche Petroleum Mij. E.P. 481,235, 8.3.38. Desulphurizing of hydrocarbons (containing carbonyl sulphide) and < 7 carbon atoms in the molecule by treating them in the liquid phase with anhydrous alcoholic KOH and then treating the mixture further with fresh aqueous alcoholic KOH.

F. R. Moser. U.S.P. 2,109,866, 1.3.38. Improving the anti-knock rating of motor spirit by contacting it in the vapour state with boron phosphate below the normal reforming temperature.

L. V. Chaney and A. E. Buell. U.S.P. 2,111,487, 15.3.38. Sweetening distillates containing mercaptans and partially saturated with air by passing the oil through a solid adsorbent impregnated with a copper salt solution and a chloride.

H. E. Drennan. U.S.P. 2,112,335, 29.3.38. Apparatus for contacting vapours with solids—*e.g.*, vapour-phase treatment of hydrocarbon distillates.

W. S. E. C.

Gas, Diesel and Fuel Oils.

753. Patents on Kerosine. Edeleanu Gesellschaft. E.P. 481,647, 15.3.38. Pre-cooling device for oil and solvent for use in the SO_2 treatment of oils.

F. M. Archibald. U.S.P. 2,110,283, 8.3.38. Removal of corrosive sulphur compounds from acid-refined petroleum oils. The oil is brought into contact with an anhydrous alcoholic solution of an alkali metal hydroxide and heated to 85–160° C. The alcohol is completely removed by air-blowing, and the oil is then passed through an adsorptive filtration medium in which the sulphur compounds with the alkali metal are adsorbed.

W. S. E. C.

See also Abstract No. 751.

Lubricants and Lubrication.

754. Some Investigations on the Constitution of Mineral Lubricating Oils. E. H. Kadmer. *Oel u. Kohle*, 1938, **14**, 1–6.—Since it is practically impossible to separate lubricating oils into their constituent hydrocarbons by fractionation, solvent extraction or other known means, different methods must be used to gain some insight into their composition.

The three types of hydrocarbon—paraffin, naphthene and aromatic—are to be found in these oils, and in this paper the typical physical properties of each of these groups are described. All lubes contain members of each of these groups, and some idea of their relative proportions can be obtained from the properties of the oils.

Some of the physical characteristics of oils bear a relation to each other. These are: (1) the density, d_{20}; (2) Ubbelohde's "viscosity pole height," *Vph*; (3) Ubbelohde's "viscosity slope," *m*; (4) Dean and Davis' viscosity index, *Vi*; (5) aniline point, *AP*; (6) mean molecular weight, *m.M.G.*; (7) refractive index, $nD/20$; (8) the dispersion.

The behaviour to oxidation and the Ring analysis method of Vlugter, Waterman and van Westen have also been considered.

The d_{20} of 140 refined lubes have been plotted against their *Vph*, and on the same graph viscosities *E.* 50 against *Vph*. Although the points showed some scattering, it was nevertheless seen that low values of d_{20} were associated with low values of *Vph*, whilst high values of d_{20} were associated with high values of *Vph*.

An even better relationship was found to exist between d_{20}, *E.* 50 and *m*.

In this case with decreasing values of *m*, values of d_{20} decreased, whilst the values of the Engler viscosities *E.* 50 increased. It is pointed out that synthetic oils made by the Fischer–Tropsch process do not fall into line with ordinary lubricating oils.

Other graphs have been drawn indicating the relationship between (*a*) *AP*, d_{20} and *E.* 50 and (*b*) *m.M.G.*, d_{20} and *E.* 50.

The authors discuss a formula put forward by Fenske, Cluer and Cannon for calculating the mean molecular weight from a knowledge of the viscosity, Saybolt seconds at 100° F. and the viscosity index. They show that this formula has only a very limited application. This also appears to be true of other empirical formulæ put forward to correlate certain properties.

D. L. S.

755. Carbon Residue Estimation on Lubricating Oil. C. I. Kelly. *Petrol. Times*, 2.4.38, **39**, 429.—Experimental data are presented to support the contention that the results of Conradson Carbon Residue (C.C.R.) and Ramsbottom Carbon Residue (R.C.R.) determinations are connected linearly. Both tests have been carried out on a series of 92 lubricating oils, with results which suggest the following relationships.

C.C.R. = 1·515 (R.C.R. − 0·12), where R.C.R. is greater than 0·2.
R.C.R. = 0·12 (C.C.R. × 0·66), where C.C.R. is greater than 0·12.

The relationship is less precise where the values are below the specified minima. In these circumstances the following equations give reasonable approximations :

C.C.R. = 0·7 (R.C.R. − 0·03), where R.C.R. is less than 0·2%.
R.C.R. = 0·03 + (C.C.R. × 1·45), where C.C.R. is less than 0·12%.

It is suggested that the manipulative difficulties attendant on the determination of Conradson Carbon Residue are so much greater than those connected with the Ramsbottom test that these relationships warrant careful consideration. H. G.

753. **Measurement of Wear and Lubricating Properties.** Anon. *Petrol. Times*, 2.4.38, **39**, 432.—The Smith–Wear Tester consists essentially of a hardened steel ball, located in the recessed end of a shaft rotating at controllable speed, and impinging on a flat-faced metal disc which is held rigidly against the ball under spring pressure and sloped at an angle of 45°. Filtered oil is circulated continuously over the test-piece. The amount of the ball's circumferential travel is directly measured in feet, and the machine can be set to stop automatically after the traverse of a predetermined distance. Controls are also fitted which allow the test-piece to be advanced and released intermittently, or the motor to start and stop at intervals. Wear is assessed by measuring the diameter of the impression on the test-piece. This can be done without dismantling by means of a microscope mounted integrally over the test-piece. H. G.

757. **Patents on Lubricating Oil.** H. D. Elkington. E.P. 482,253, 25.3.38. Dewaxing mineral oils by cooling and separating the wax in solid form—the process being carried out in the presence of aluminium stearate and/or magnesium stearate and/or ferric stearate together with cracked residues.

Texaco Development Co. and A. H. Stevens. E.P. 482,327, 21.3.38. Dewaxing of hydrocarbon oil using acetone–benzol at 0° F. and incorporating in the oil small quantities of a wax crystal modifying material consisting of a mixture of crude montan wax and aluminium stearate.

S. W. Ferris and E. R. Birkhimer. U.S.P. 2,109,476, 1.3.38. Solvent extraction of hydrocarbon oils using nitrobenzene and carbitol.

Per K. Frolich. U.S.P. 2,109,772, 1.3.38. Preparation of thickened lubricating oil by adding to a lubricating oil of viscosity index below 50, ½–25% of a resin prepared by treating cracked naphtha boiling below 180° C. with anhydrous aluminium chloride at temperatures below 40° C. and separating the resin from the resultant mixture.

J. A. Anderson. U.S.P. 2,109,895, 1.3.38. Refining lubricating oil by first deasphalting and then treating the extracted deasphalted oil with a selective solvent and redistilling the raffinate obtained under non-cracking conditions.

M. E. Spaght. U.S.P. 2,110,311, 8.3.38. Decolorizing lubricating oil raffinates obtained from SO_2 extraction, by extracting them with acetic, propionic, butyric or *iso*butyric acids, etc.

E. B. Hjerpe and W. A. Gruse. U.S.P. 2,110,627, 8.3.38. Solvent dewaxing of hydrocarbon oils using acetone and benzol. The wax is removed by cooling and the cold filtrate is then SO_2-treated.

J. M. Whiteley and G. A. Beiswenger. U.S.P. 2,110,845, 8.3.38; G. F. Chase. U.S.P. 2,110,905, 15.3.38. Propane deasphalting of hydrocarbon oils.

M. L. Berry. U.S.P. 2,111,548, 22.3.38. Refining of lubricating oils with sulphuric acid and separating the sludge. The separation is facilitated by diluting the oil with a normally liquid aliphatic hydrocarbon diluent containing 75% of *iso*pentane.

H. R. Batchelder and W. E. Kuentzel. U.S.P. 2,111, 831, 22.3.38. Polymerization of ethylene for the production of lubricating oils in the absence of active catalysts at 500–750° F. and under 2500–10,000 lb. pressure per sq. in. for a time within ± 10% of that defined by $50 \log T = 50 + (750 - t) \log 3$, where T is the time in mins., and t in °F.

A. L. Lyman. U.S.P. 2,111,864, 22.3.38. Solvent extraction of hydrocarbon oil using aniline together with one of the following: benzene, toluene, ethylene dichloride, amyl alcohol, etc.

A. A. Wells. U.S.P. 2,111,920, 22.3.38. Separation of sludge from acid treatment of lubricating oils for storing. The sludge is diluted with 5–15% of water to stabilize it against further chemical action.

D. B. Banks and P. D. Barton. U.S.P. 2,111,957, 22.3.38. Depropanizing wax-propane mixtures.

S. W. Ferris. U.S.P. 2,111,968, 22.3.38. Solvent refining of hydrocarbon oils using chloronitrobenzene.

W. H. Sowers. U.S.P. 2,112,313, 29.3.38. Reducing organic acidity of lubricating oils by agitating the oil together with an aqueous solution of alkali with an incondensable gas. The reaction products are separated from the oil and the remaining acidity is neutralized in a second step.

J. E. Schulze. U.S.P. 2,112,350, 29.3.38. Vacuum distillation of lubricating oils.

F. M. Clark. U.S.P. 2,112,735, 29.3.38. Mineral oil containing 1% of unsaturated aliphatic hydrocarbons and 4–8% of residual unsaturated aromatic hydrocarbons. The oil is claimed to form less than 0·5% by wt. of sludge when heated in the presence of metallic copper for 55 days at 110° C. W. S. E. C.

Asphalt and Bitumen.

758. Structure in Asphalts. R. N. Traxler and C. E. Coombs. *Industr. Engng Chem.*, 1938, **30** (4), 440—By studying the flow characteristics of asphalts it has been found that they possess varying degrees of internal structure, depending to a large extent on the method of processing, source of material and temperature at which the rheological test is made. Asphalts which show distinct anomalous flow characteristics as indicated by a high rate of age-hardening, marked elastic properties, etc., give surface designs when treated with partial solvents such as ethyl ether and petroleum naphtha; with asphalts which are essentially viscous no such surface designs are obtainable. Consequently the presence of a surface pattern may be an indication of the presence of structure in an asphalt. H. E. T.

759. Flow Properties of Asphalts Measured in Absolute Units. R. N. Traxler. *Industr. Engng Chem.*, 1938, **30** (3), 322.—A rotating cylinder viscometer suitable for measuring very high viscosities is described. It is intended for application to viscous asphalts at service temperatures. Results obtained on asphalts from various sources are shown in comparison with standard tests (penetration and ring and ball).

P. D.

760. Recent Patents for Road-Surfacing Materials. H. Goette. *Asph. u. Teer*, 1938, **38** (15), 219–221.—Recent patents relating to road-surfacing materials are discussed. A joint filler claimed to have exceptional resistance to chemical and weather action and to be ductile over a wide temperature range is prepared by heating 5 parts of milled used rubber and 3 parts of cumarone resin for 2 hrs. at 175° C. and adding 2–4 parts of quartz sand. As a binder for road surfacing with granite chippings, sand, etc., a diluted dispersion of rubber containing not more than 10 gm. solid per 100 c.c. is used in proportions to give 10 parts of rubber to 90 parts aggregate, the rubber being precipitated by addition of magnesium or calcium silicate or magnesium or zinc sulphate, acetic acid, etc., to the aggregate. Water-insoluble soaps are used with cement or chalk as binders to give surfacings which are said to combine the advantages of bituminous and concrete surfacings. The properties of the soaps can be modified by use of different proportions and admixture of constituents; oils, tars or bitumen may be added. Alkaline soaps may also be used alone or with oils,

etc., when calcium or magnesium salts are added to the aggregate before or after mixing with soap. Compression is obtained by methods normally employed for bituminous materials. Coloured surfacings are prepared with various resins and aggregates of suitable colour and pigments or dyes. A liquid binder is composed of tar or rosin oils, etc., and chlorinated rubber; this binder may contain asphaltic bitumen and/or animal or vegetable oils, and can also be applied as an aqueous solution.
A. O.

761. Classification of Tars and Oils According to Their Physical Properties. T. H. Blakeley. *J. Soc. chem. Ind.*, 1938, **57** (1), 7–14.—The author discusses a method of classification of tars and oils which is based on the relationship between properties such as specific gravity, viscosity and volatility and aromaticity. It is shown that when specific gravity is plotted against viscosity, various tars and oils fall into different arbitrary origin bands; the viscosity scale may be replaced by an equi-viscous temperature scale for tars and pitches or by softening-point scales for pitches. The scope of the classification has been extended by the derivation of an approximate additive function of viscosity of the form log (constant + log viscosity); this permits the estimation of the properties of mixtures and the correlation of various properties of materials.
A. O.

762. Tars. G. Martininghi. *Olii min.*, 1938, **18**, 1–7.—Tars are classified as distillates and residues, each group being subdivided according to the source of the material. Detailed analyses are given of a large number of distillate tars from various sources.
C. C.

See also Abstract No. 751.

Special Products.

763. Petroleum Oils as Insecticides. C. Potter. *Oil Gas J.*, 24.2.38, **36** (41), 85.—A survey is presented of the use of petroleum oils in applied entomology covering:

(1) Horticultural, agricultural and glass-house entomology,
(2) Household and industrial entomology, and
(3) Medical and veterinary entomology.

With regard to Class 1, the oils generally used are emulsified in water, and are of two main grades for winter and summer conditions. Specifications quoted for Winter (W) and Summer (S) oils are as follows:—

	W.	S.
Sp. Gr. at 60° F.	0·86–0·92	0·86–0·92
Min. 90% above	315° C.	300° C.
„ 50% „	350° C.	340° C. and below 365° C.
„ 20% „	380° C.	370° C.
„ 80% below	—	390° C.
Visc. R. 1 at 70° F.	125/500 secs.	75/150 secs.
Unsulphonatable residue	⩽ 60%	⩽ 90%

The effects on both the insect and the plant have to be balanced, since increase in the boiling range, for example, may increase the toxicity towards the insects, but have a deleterious effect on the plant. The size of the drop and the type of emulsifier used are also of importance. The emulsions are either miscible oils or stock emulsions. Summer sprays in which oil alone is the toxic agent (1–2% oil) are used against codlin moth and red spider on fruit trees, and San José scale on citrus. Winter sprays (5–7·5% oil) are also used against capsid bugs, eggs of the fruit-tree red spider, woolly aphis and winter moths. They may be used instead of, or in conjunction with, lead arsenate sprays or hydrogen-cyanide tent fumigant. In glass-houses oil sprays are used against red spider, thrips, scale insects and mealy bugs, but may interfere with the transpiration of plants. Petroleum oils are often used in conjunction with lead arsenate, nicotine, pyrethrum and derris in the summer, and tar oils in the winter, and also with fungicides.

2. For household and industrial insecticides petroleum oils are used as carriers

for other toxic agents—*e.g.*, pyrethrum, thiocyanates or derris. A recommended oil is a colourless, odourless, volatile fraction of gravity 49·50° A.P.I., flash point open cup 120° F., I.B.Pt. 350° F., E.Pt. 510° F., colour Saybolt 30 +, and iodine no. 1. For clothes-moth spray a more volatile oil of flash point 115–125° F., I.B.Pt. 325° F. and E.Pt. of 450° F. is used. In industry, pests in stored goods and grain are controlled by similar sprays. Special pyrethrum sprays against Indian meal moth and Cacao moth use an oil similar to medicinal paraffin of following specification : sp. gr. 0·862, flash point closed 320° F., open 335° F., Visc. R. 1 at 70° F. 118 secs., pour test — 30° F.

3. For medical and veterinary insecticides oils of boiling range 200–300° C. are used against the larvæ and pupæ of mosquitoes. More viscous oils do not penetrate the breathing pores, whilst lighter oils are too volatile. Crude oils are preferred to refined owing to their chemical toxic action and better spreading qualities. For the control of stable fly, a water emulsion of pine oils, pyrethrum and petroleum oil of the following characteristics is suggested : Visc. S.U. at 100° F. 45/50 secs., flat distillation curve largely between 550° and 650° F., and end-point not over 700° F., sulphur not over 0·4%, unsulphonatable residue not less than 70%. A lighter oil is likely to burn the cattle, owing to its solvent and penetrating power, whilst a heavier oil may interfere with the physiological processes. C. L. G.

764. Viscosities of Dammar Solutions. C. L. Mantell and A. Skett. *Industr. Engng Chem.*, 1938, **30** (4), 417.—This paper deals with the importance of solvents in the preparation of dammar solutions. Dammar is a resin, finding commercial application in adhesives and cements, dry colours and pastes, inks, lacquers, finishing compositions, decorative coatings, linoleum oilcloth, paints and varnishes, paper sizing, plasters, rubber and wax compositions as well as solutions in petroleum solvents for a wide variety of purposes.

Batavian dammars are soluble in all coal-tar solvents, petroleum solvents, hydrogenated petroleum solvents, terpenes, and chlorinated solvents ; they are also soluble in tetralin, esters and a few ethers—*i.e.*, Batavian dammars are soluble in all of the common varnish solvents. Slightly lower viscosities are obtained for the solutions with the more powerful solvents. Distillation range of a petroleum solvent has an effect on such dammar solutions, solvents with high distillation ranges yielding solutions of high viscosity. The viscosity of these solutions increases logarithmically with increase in concentration.

From viscosity results obtained on Batavian dammar solutions, toluene is found to be the best solvent, with a hydrogenated petroleum spirit second and solvent naphtha third. H. E. T.

765. Patents on Special Products. G. W. Johnson. E.P. 482,277, 21.3.38. Manufacture of soaps from oxidation products of non-aromatic hydrocarbons.

D. Gardner. E.P. 482,157, 24.3.38. Manufacture of magnesium or alloys—by mixing anhydrous magnesium sulphide with low-temperature carbonization coke and heating the mixture in hydrogen at temperatures high enough to decompose the sulphide and distil off the magnesium.

Electric Smelting and Aluminium Co. E.P. 482,326, 28.3.38. Treatment of aluminous siliceous substances containing substantial quantities of silica for the production of aluminium. These compounds are mixed with a calcium compound and a sodium compound in proportions to form a furnace charge which is sintered, and the alkali metal aluminate is dissolved out from the sinter. W. S. E. C.

Detonation and Engines.

766. Some Problems Regarding Modern Aero Engines and their Fuels. F. R. Banks. *Tekn. Tidskr.* (Automobil- och Motorteknik), 22.1.38, (1), 1–3 ; 19.2.38, (2), 9–15 ; 19.3.38, (3), 17–24.—A lecture delivered before the Swedish Association of Engineers and Architects following substantially the same lines as that previously delivered before the I.P.T. (see *J. Instn Petrol. Tech.*, 1937, **23**, 63). R. F. S.

767. Swedish State Railways' new rail Buses. E. Nothin. *Tekn. Tidskr.*, 16.4.38 (Mekanik No. 4), 46–47.—A new type of rail bus for especial use in long-distance travel, equipped with 6-cylinder Scania Vabis engines constructed for burning 25% alcohol–gasoline blends. The cylinders measure 110 × 136 mm., and the engines develop 130 h.p. at 2200 r.p.m., but operate normally at 2000 r.p.m., equivalent to a speed of 80–85 km./hr. The performance of this type of equipment compares favourably with 1500-h.p. steam-powered locomotives. R. F. S.

768. Motor-driven Railway Equipment. Th. Nilsson. *Tekn. Tidskr.*, 19.2.38 (Mekanik No. 2), 20–25.—Description of standardized construction developed by the Motala Works. Four types of motor cars are treated, the larger ones equipped with two Mercedes–Benz diesel engines, one on each bogie and independent of each other, developing 135 h.p. at 1700 r.p.m., whilst the smaller are powered with 110-h.p. Hesselman engines operating at 1600 r.p.m. R. F. S.

769. Exhaust Systems of Two-stroke Engines. H. O. Farmer. *Engineering*, 1.4.38, **145**, 367.—Investigations made into the effect of the exhaust system on the performance of small crankcase-scavenged two-stroke engines showed that the exhaust-pipe length had a controlling influence on the scavenging of the cylinder and the performance of the engine even when an expansion chamber is used. The expansion chamber volume and exhaust-pipe diameter are additional influential factors.

Four separate arrangements of the exhaust system were used in the experiments; the pipe lengths being varied in each :—

(*a*) A plain pipe coupled directly to the cylinder.

(*b*) A silencer or expansion chamber bolted directly on to the cylinder with a pipe to atmosphere beyond.

(*c*) A pipe coupled directly to the cylinder passing to a silencer to which a second pipe is attached.

(*d*) A plain pipe with an absorption type of silencer on the end, but with no expansion chamber in the system.

The results indicated clearly that certain variations of each arrangement must be avoided if satisfactory engine performance is to be obtained. It is shown how by the use of formulæ, it is possible to calculate the equivalent length of any system of the nature used so that pipe-lengths can be arranged to avoid a bad combination.

In conclusion, reference is made to the self-induction engine, which makes use of the pressure variations in the exhaust pipe to scavenge the cylinder, and pump in the fresh-air charge without the use of an auxiliary air pump. E. F. C.

770. Recent Developments in High-speed Oil Engines. S. J. Davies. *Engineering*, 25.3.38, **145**, 342; 8.4.38, **145**, 400.—This paper consists mainly of an outline of the valuable research work which has been carried out since the year 1931 in connection with some of the complex problems met with in the study of the processes of fuel injection and combustion in high-speed oil engines.

Following a summary of the practical conclusions reached by the author in an investigation into the processes in an experimental fuel injection system up to the nozzle, the results of several experimenters' work in examining the subsequent injection processes in the engine cylinder are given.

Progress made in the research of a more fundamental character into the circumstances which affect the ignition of liquid fuels has to a large extent promoted experimental work towards obtaining a method of judging the suitability of various fuels for use in engines. As a result of co-operative work in this direction the cetane number or value has been generally accepted to-day as a basis for comparing the ignition quality of diesel-engine fuels. Alternative methods of conducting a test for cetane number are described.

An important factor in connection with the study of the fuel injection and combustion processes and achievement of improved engine performance has been the development of electrical measuring and recording instruments. Reference is made to the application of the cathode-ray tube not only for observing fuel injection and

combustion phenomena, but also to the measurement of strain in the moving and stationary members of engines. The results of the work of several authorities to obtain the "noise spectrum" of internal-combustion engines are also quoted.

In conclusion, an outline is given of the attempts made to improve the performance of the high-speed diesel engine, particularly in regard to increasing the air charge to the cylinder by utilizing in some way the energy in the escaping exhaust gases.

E. F. C.

771. Hydraulic Brake Fluids. R. R. Fulton. *Industr. Engng Chem.*, 1938, **30** (4), 422.—The requirements, composition, methods of testing and evaluation of hydraulic brake fluids are discussed. The chemical composition of commercial fluids is given and references to the more important patents are presented. It is concluded that the most satisfactory brake fluids are those containing a castor-oil base in a suitable solvent. The factors governing the choice of this solvent are discussed.

J. W. H.

See also Abstracts Nos. 739, 750.

Coal and Shale.

772. Patent on Coal. B. Blakemore. E.P. 481,456, 11.3.38. Low-temperature distillation of liquid or solid carbonaceous substances under reduced pressure in the absence of oxygen or water vapour to produce volatile liquids. The heating effect is obtained by causing high-frequency electric induction to produce eddy currents in a conductor within the material.

W. S. E. C.

Economics and Statistics.

773. State of Industry in U.S.S.R. I. Ganitzki. *Monit. Pétr. roum.*, 1938, **39** (6), 445–447.—Details are given of the projected production for the heavy industries, which include coal, petroleum, iron, etc., in U.S.S.R. for 1936–1938 and the realized production for 1936–1937.

A. O.

BOOK REVIEWS.

The Science of Petroleum. Volume I.* Pp. xxvi and 1–836. The Origin and Production of Crude Petroleum (being Part I, Sections 1–17).

The first volume of the *Science of Petroleum* illustrates particularly well its general character—it is essentially a volume of scientific papers and essays, in each of which the author interprets, in the light of his own knowledge or understanding, a limited field. The reader must not expect, therefore, to find his information already digested for him; he is provided with an excellent series of meals of varied character and weight, and must rely on his own digestion. This is as it should be; for many years must pass before the last word is said on the origin of petroleum, to choose but one example. In the meantime it is of immense advantage that there should be five separate contributions from five separate authors on this subject. True, a certain amount of repetition is inevitable and a considerable amount of disagreement, and sometimes, though less frequently, certain omissions; but the result is to bring within the compass of one volume not only a vast amount of factual material otherwise difficult of access, but also the critical exposition from diverse angles of fact and theory which could scarcely be found in a volume by one or a few authors.

The first section deals with nomenclature, and Mr. Schwarz of Vienna brings together comparable names from no less than twenty-one countries. He tells us that Maidan-i-Naphtun is simply Persian for oilfield, but perhaps we ought to be glad he does not announce that the delightfully euphoneous Yenangyaung is really only the Burmese for "stinking-water-river."

The second section, on statistics, by G. Sell quotes figures to the end of 1935, and has an interesting calculation of the proportion of total production accredited to each country. To the end of that year the share of the United States had been 63·78%—not very different from the proportion in 1935, whereas Mexico's total share of 7·06% compares with a little over 2·6% in 1935.

In the third section, on the origin of petroleum, Professor Illing stresses that the oil-bearing rocks of most fields are marine. Would not the geologists in many fields prefer to say shallow-water marine, or even brackish water, and stress rather the association of oil with areas of deposition where sediment-laden rivers were throwing their load in estuaries or shallow seas? Throughout the contributions in this section the several references to Cunningham-Craig's "Oilfinding" of 1912 seem to indicate that much said or believed over 25 years ago cannot yet be confirmed or refuted.

A hundred and forty pages are devoted to the distribution of oil in the world and a description of the world's oilfields. This section includes twenty-eight contributions, which naturally vary greatly in length and character. Some are so sketchy as to be of little use (East Indies), some are excellent examples of much in little (Burma and Assam, by G. W. Lepper), others are learnedly geological (Iran, by G. M. Lees and Australia, by W. S. Woolnough). Throughout this section there is unfortunate evidence of that conspiracy of silence which ties the tongues of oil geologists. The companies pay vast sums of money for their geological investigators, and perhaps it is only natural that they should withhold any information which might help competitors. So we look in vain for what is really the position in the Bahrein Islands and what are really the hopes and fears in Britain; we find no mention of developments in Bolivia, nor of the old industry in Japan. The section on Russia suffers from lack of truthful authoritative information, though the English author has done well with the facts available. On the whole this is the most disappointing section, and would have been helped by an extended treatment of the world distributions of oilfields.

A section with two articles is devoted to the migration of petroleum. The very frequent occurrence of oil in thinly laminated beds of sand and clay, each double

* For Reviews of other parts of *Science of Petroleum* see *J.I.P.T.*, 1938, **24** (174), 198A–901A and **24** (175), 228A.

lamina deposited in one season of high and low water, and the consequent effective sealing of the mother substance under anaërobic conditions, seem to have been somewhat overlooked.

The subsequent sections on conditions of accumulation and methods of exploration can only be mentioned, but the detailed discussion of geophysical methods is especially valuable.

Sections 9 to 17 go on to deal with drilling, production, oil-field practice, transport and storage, and occupy rather more than half the volume. The matter tends to be descriptive, and less controversial than that in the first half, but the whole bears testimony to the unceasing care and watchfulness of the Editors throughout their herculean task. L. DUDLEY STAMP.

The Cause of Cancer. By David Brownlie, B.Sc., 1938. Chapman and Hall Ltd., London. Pp. 208. 7*s.* 6*d.*

It will not surprise anyone acquainted with the literature of cancer—in which a free-lance propensity to theorize regarding causation recurs so frequently—to read that one more theory has been formulated, but that, on this occasion, it has been published in the guise of a popular theme, with technical phylacteries, is a departure which, with its possible enhancement of cancer neurosis, is not to be commended.

In theories of the past, offending agents have included many articles of diet and conditions of life. Even medical giants like Jonathan Hutchison and Frederick Treves fulminated—the former against fish and the latter against preserved meat—whilst others have impugned vegetables, both raw and cooked, salt, alcohol (particularly beer and cider), and, going farther afield, certain localities, climates, soil conditions and even trees. It was perhaps to be expected, therefore, that the investigations into the carcinogenic properties of certain high-temperature coal-tar derivations, conducted by Cooke and Kennaway and their co-workers, should have stimulated a free-lance denunciation in this direction. The author of this theory, however, impugns high-temperature carbonization in general and domestic cooking and heating gas in particular. Put in his own words, he believes "that most human cancer, and not only a very small portion of it, is due to complex poisonous products from high-temperature combination of coal and other carbonaceous material, which largely enter the body in food, with manufactured towns gas and the smoking of meat, fish, and other products playing a primary part."

Whilst much of the volume is occupied with historical, statistical and other detail, the arguments put forward to substantiate this theory seem singularly lacking in critical value, since they omit mention of two facts which are of much appositeness. The researches already referred to have shown that the carcinogenic material resulting from high-temperature carbonization (chiefly 1 : 2-benzpyrene) is present only in the pitch residue, and that *ad hoc* experiment has proved that neither this nor any other known carcinogenic product can be demonstrated in the gas. Secondly, while it is well known that epitheliomata can be produced on the skin of mice by the frequent, regular applications of certain of these coal-tar derivatives, it is also a fact that up to the present time it has not been possible to induce any malignant growth by feeding these products to any cancer-vulnerable animal.

In regard to the author's comments on the carcinogenic properties of crude oil, which are likewise generalized on, the information is out of date. Dr. Scott's valuable work on the Scottish shale-oil industry is some fifteen years old, and in that period much has been done by inculcating cleanliness and preventing skin irritation to bring about a considerable improvement in the occurrence of papules and warts and a practically complete disappearance of skin cancer.

The author cannot, apparently, make up his mind as to whether carbon monoxide gas should be included in his indictment, but the evidence he produces that it is a "possible secondary cause of cancer" seems no more convincing than that which attempts to support his main thesis that high-temperature carbonization is the cause of most human cancer.

Whilst everyone will be in agreement with propaganda created to improve the conditions of modern life in regard to food, atmospheric and water pollution and the like, it is of rather more than scientific interest to differentiate between proved

and hypothetical causes of diseases and, particularly, of malignant disease, to which it is of some importance that the public's attitude should not be vitiated by fallacious theorizing. T. H. BISHOP.

Polymerization of Unsaturated Hydrocarbons. By J. J. Leendertse. Doctor's Thesis Technical University, Delft, The Netherlands. Pp. 197.

This dissertation deals in the main with the polymerization of a number of unsaturated hydrocarbons (viz., ethene, butenes, pentenes, octenes, decenes, tri*iso*-butene, hexadecene, *cyclo*hexene, α-pinene and tetralene) at low temperatures (− 78° to + 70° C.), with the aid of $AlCl_3$ as catalyst. The purpose was to examine the chemical nature of the reaction products as a function of the nature of the base materials used and of the reaction conditions applied.

The reaction products were examined by determining the molecular weight, the olefinic unsaturatedness, the behaviour upon analytical hydrogenation and upon destructive hydrogenation and destruction. The utility of each of these methods of test was verified.

An attempt was furthermore made to throw more light on the structure of the polymers by means of the specific refraction and the parachor of the hydrogenated products. The determination of the specific refraction as a function of the molecular weight provides a useful criterion for the *cyclic character* of the products examined. Whether and to what extent the parachor provides a standard for the *degree of branching* will not appear until there are enough pure hydrocarbons of known structure available for parachor testing.

It again clearly emerges from Dr. Leendertse's investigations that, even at very low temperatures, the polymerization reactions with $AlCl_3$ as catalyst are exceedingly complicated. The path to a proper understanding of these reactions is a very long and difficult one, but Dr. Leendertse's dissertation is undoubtedly an important step in the right direction. J. SMITTENBERG.

BOOKS AND PUBLICATIONS RECEIVED.

Report on Explosion in Kerosine Tank at Killingholme, Lincolnshire. By H. E. Watts. Pp. 16. H.M. Stationery Office. 6*d*.

On 25th May, 1937, an explosion occurred at Killingholme, Lincolnshire, whilst Roumanian kerosine was being pumped into a storage tank from a tanker at the Admiralty Jetty. The temperature of the contents of the tank prior to explosion was below the flash point of kerosine, thus exonerating kerosine vapour as the cause. The presence of some other ignitable mixture in the tank was also disproved, and there was no question of the ignition being caused by smoking or sabotage, etc. A consideration of the facts indicated that ignition must have been caused either by a spark produced by static electricity or by some agency inside the tank. An examination of the kerosine discharged from the tanker showed that it did not possess any extraordinary characteristics. In view also of the fact that the pipe-line and tank in question were to all intents and purposes earthed, and the relative humidity of the atmosphere at the time of the ignition was 90%, it was thought that the explosion was not caused by a spark produced by a static charge of electricity. A sample of the water taken from the bottom of the tank contained a large number of bacteria, including sulphate-reducing bacteria, and a gas analysis of the air collected from the sample of tank liquid revealed the presence in the air of small but definite amounts of methane or ethane. It is suggested that this methane originated from the gas bubbles, and was produced by microbiological activity in the storage water.

The Inspector recommends that the question of biological production of iron sulphide and possibly phosphoreted hydrogen in petroleum tanks, and the conditions required to bring about spontaneous ignition by this means, should be investigated.

Annual Reports of the Society of Chemical Industry on the Progress of Applied Chemistry, Vol. XXII, 1937. Issued by the Society of Chemical Industry. Pp. 748. Indexes pp. 749–816. Price 12*s.* 6*d.* (7*s.* 6*d.* to Members of the Society of Chemical Industry).

This volume comprising 748 pages summarizes the developments during the past year in twenty-four different industries. Of particular interest to the Petroleum Industry is the report on mineral oils, again written by Mr. W. W. Goulston, who has surveyed in a condensed yet comprehensive manner the main developments in scientific trends in the various branches of this Industry. Starting with the "Corrosion of Pipe-lines" and ending with "Analysis and Testing," the various products of the Industry—Crude Oil, Motor Spirit, Lubricating Oils, Paraffin Wax, Fuel Oil, Asphaltic Bitumen, are all dealt with in turn. Reference is also made to recent trends in hydrogenation and polymerization practice and to the chemistry and chemical derivatives of petroleum.

The report on "Fuel," written this year by Mr. J. G. King, deals chiefly with coal, and contains an interesting reference to powdered fuel for diesel engines. Mr. King devotes three pages to synthetic fuels, with particular reference to the Fischer Tropsch Process.

The report by Messrs. M. B. Donald and H. W. Thorp on General Plant and Machinery contains some references to Fluid Flow and Metering and a section on Distillation. Although most of the other reports do not deal specifically with the Petroleum Industry, they are so interestingly written and contain so much valuable information that they are bound to be appreciated by anyone interested in the application of chemistry to industrial problems.

The Chemistry of Petroleum Derivatives, Volume II, 1937. By Carleton Ellis. Pp. 1464. Illustrations 350. Reinhold Publishing Corporation. Messrs. Chapman and Hall, Ltd., 11, Henrietta Street, W.C.2. Price £5 net. *See J.I.P.T.*, **24** (175), p. 229A, May, 1938.

Fifth Report of the Corrosion Committee (Iron and Steel Institute Special Report No. 21), 1938. Pp. xviii + 448. Iron and Steel Institute, 28, Victoria Street, London, S.W.1. Price 16*s.* (Members, 10*s.*).

The Report is divided into six Sections. Section A, which is introductory, gives the constitution of the Committee, describes the present position of the Committee's work and the contents of this Report, and briefly summarizes the conclusions so far reached by the Committee. Section B deals with the Committee's field tests on atmospheric corrosion, in which connection many further quantitative results are given. Section C refers to the Committee's work on marine corrosion. Section D describes the work of the Laboratory Research Sub-Committee, and includes six individual contributions submitted to the Sub-Committee. Section E constitutes the First Report of the Protective Coatings Sub-Committee, and includes three papers submitted to this Sub-Committee by individual authors. Section F deals with various other matters considered or investigated by the Committee. These comprise investigations of two cases of corrosion in concrete, a case of service corrosion of some steel sleepers in a railway line near the sea, and the corrosion of paddle steamers in Indian waters. This section also includes a short paper on sulphate-reducing bacteria.

Lubricating Oil Tests and their Significance. Fifth Revised Edition. By J. E. Southcombe. Pp. 96. Index pp. 97–100. Price 3*s.* 6*d.*

Recent developments in the manufacture and refining of lubricating oil are briefly dealt with, and the general methods of testing oil described, with particular attention to the practical significance of each test and its relationship to the lubrication of engines and machinery.

Petroleum Fuels in Canada. Deliveries for Consumption Calendar Year, 1936. By J. M. Casey. Pp. 20. Issued by Bureau of Mines, Department of Mines and Resources in co-operation with the Dominion Fuel Board. No. 789. Price 10 cents.

During the calendar year 1936, deliveries of petroleum products for fuel amounted to 1157 or, including the 56 consumed in refineries, to 1213 million imperial gallons, consisting of 555 of fuel oil, 34 of kerosine and 624 of gasoline. Over 45,000 short tons of petroleum coke were also delivered (and consumed in refineries) for fuel.

Flow Characteristics, Composition and Some Liquid-Phase Properties of Hydrocarbon Fluids from a "Combination Well." By C. K. Eilerts and M. A. Schellhardt. U.S. Bureau of Mines. Report of Investigations No. 3402.

This report is limited to preliminary results of field and laboratory tests on one well in one field. Ratios of gas to hydrocarbon liquid, pressures and temperatures within the well and the surface-recovery system and other well-flow data were observed over a considerable range of operating conditions in the well.

Calibration of Positive Displacement Oil Meters. By R. E. Heithecker and W. B. Berwald. U.S. Bureau of Mines. Report of Investigations 3396. Pp. 21.

Two different types of calibration tests are discussed. The first is a direct calibration to determine the accuracy of the meter counters of four different meters, through which measured quantities of weathered oil were pumped at different rates of throughput. The second type of test was made to determine the magnitude of error when metering a gas-saturated oil in which a drop in pressure occurred upstream from the meter, allowing liberated gas to pass through the meter with the oil.

British Standard Specification No. 616, for the Sampling of Coal Tar and Its Products. Revised April, 1938. Pp. 24. British Standards Institution, 28, Victoria Street, S.W.1. Price 2*s.* net.

This Specification deals with general precautions, apparatus and general procedure for sampling packages (casks, drums, sacks, etc.), tanks and pipe-lines, the method of drawing a bulk sample and preparation of the final sample. For the purpose of sampling, the various products are classified as follows: (*a*) mobile homogeneous liquids, (*b*) mobile heterogeneous liquids, (*c*) viscous and partly solidified products and (*d*) solid products.

British Standard Specification No. 791, for Bomb Calorimeter Thermometers. April 1938. Pp. 9. British Standards Institution, 28, Victoria Street, S.W.1. Price 2*s.* net.

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Geology.

774. Origin of Petroleum. E. Berl. *Petrol. Technol.*, May 1938 (Amer. Instn. Min. & Metall. Engrs. Tech. Pubn. No. 920), 1–18.—No other materials formed by nature occur in such enormous quantities as carbohydrates, and undoubtedly they were even more abundant in past geological ages when the temperature was higher and the carbon dioxide content of the atmosphere much greater.

The carbohydrates of plant debris which are covered by inorganic material, especially the carbonates of calcium and magnesium, zeolites and other silicates, can be decomposed by heat treatment to form water-soluble substances which afterwards undergo further geochemical changes to form oil. On the other hand, they may be converted into bituminous coal. Bacterial decomposition of these carbohydrates proceeds only to a limited extent, and is followed by pure chemical reactions.

Carbohydrates when heated under pressure in the laboratory gave a substance—proto-product—which closely resembled natural asphalts in its properties. In the presence of alkali the proportion of this substance produced was raised at the expense of carbon-rich solid products. When cracked at 400° C. under a pressure of 110 atmos., the proto-product gave material almost free from oxygen. Undoubtedly such changes can take place in nature at a lower temperature, but in a longer time. Hydrogenation of the proto-product gave material similar to crude oil, and which contained aliphatic, naphthenic and aromatic hydrocarbons, with only a small proportion of olefines.

It is possible that ferrous iron compounds or hydrogen sulphide may act as hydrogenators or oxygen removers in nature.

Cracking and hydrogenation of natural asphalts gave the same end-products as did the same processes when applied to the proto-products.

It must be assumed that asphalts consist of aromatic nuclei with aliphatic side-chains, and it seems clear that asphalts are original, and not end-products. The transformations described are strongly exothermic, and possibly autocatalytic, taking place relatively rapidly after a period of incubation. The minerals of the mother rock may aid in the condensation of unsaturated hydrocarbons to naphthenes.

It is possible to connect oils, asphalts, natural gas, fusain, lignites and bituminous coals in the various branches of a family tree with plant material as the parent substance Carbohydrates certainly seem worthy of primary consideration as the source materials of oils and asphalts. G. D. H.

775. Geologic Occurrence of Oil and Gas in Michigan. B. F. Hake. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 393–415.—Oil occurs in the Lower Peninsula of Michigan in eleven distinct horizons, from which production has been obtained from at least nine. In age they range from Devonian to Ordovician, the rocks consisting of porous dolomites, limestones and sandstones. No systematic relationship appears to exist between the characters of the oils and the ages of the sediments in which they are found.

Although natural gas is present in some amount with the oil, it does not contribute very much to the commercial production of the State. In addition, natural gas, is encountered at nine geological horizons, ranging in age from Upper Mississippian (or possibly Pennsylvanian) to Middle Silurian. The gas is developed commercially in Michigan from sands and dolomites.

From deep wells the stratigraphic features of the State have been ascertained. Although very few wells have penetrated Silurian or Ordovician rocks in the central part of the State, these formations will doubtless be prospected in due course. It is estimated that the St. Peter's Sandstone will be reached at depths between 9000 and 10,000 ft.

Accompanying the paper are vertical sections showing the rocks penetrated by drilling in north, north-central, south and south-central Michigan. G. S. S.

776. Bibliography of Geologic Structure Maps and Cross-sections of Areas in Oil and Gas States East of the Mississippi River and some Producing States in the Mid-Continent Region. O. C. Postley. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 431–482.—The States included in this area are Alabama, Arkansas, Illinois, Indiana, Kansas, Kentucky,

Louisiana, Michigan, Mississippi, Missouri, New York, Ohio, Pennsylvania, Tennessee and West Virginia. G. S. S.

777. Graphic Treatment of Folds in Three Dimensions. A. J. Eardley. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 483–489.—Busk's graphical solutions are two-dimensional in that the strike is kept constant. In the present case the solution is given for a traverse across the axis of a plunging fold when both strike and dip vary. Curvature and thickness may be determined as well as the direction of the axis and pitch. The solution holds only for "concentric" folding, and for such folding suspected inaccuracies in dip measurements may be corrected. In the case of "similar" folding the approximate thickening or thinning may be determined.

An example is given to illustrate the method and the procedure is fully described. S. E. C.

778. Newly Discovered Section of Trinity Age in South-western New Mexico. S. G. Lasky. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 524–540.—The Little Hatchet Mountains cover about 75 sq. miles west of Hachita, S.W. New Mexico. Excepting for a small isolated outcrop of uncertain age, all the sedimentary rocks appear to belong to the Trinity (Lower Cretaceous). They range in thickness from 17,000 to 21,000 ft., of which more than 15,000 ft. is of Glen Rose or Upper Trinity age. In addition to this great thickness of sediments, there are over 5000 ft. of contemporaneous basaltic rocks; several large disconformities which indicate removal of beds thousands of feet thick; a high proportion of conglomerate, mostly intraformational; and a repetition of zones (fourfold in some cases) of similar lithology and fauna.

The section has been divided into seven formations; these in ascending order are: Broken Jug Limestone, Ringbone shale, Hidalgo volcanics, Howells Ridge formation, Corbett sandstone, Playas Peak formation, and Skunk Ranch conglomerate. Descriptions of these are given, together with a map showing their distribution.

The general faunal assemblage is similar throughout the sequence, with a repetition of certain forms at various horizons. The more significant fossils so far identified include: *Orbitolina*, *Toucasia*, *Exogyra quitmanensis*, *Pecten* and *Douvilleiceras*.

As a group the formations are of an equivalent age to part of the Bisbee group, though detailed correlation of individual formations is not possible at present.

Other than the volcanics, the rocks are beach and shallow-water deposits, deposition having taken place in a basin of geosynclinal dimensions at a rapid rate of subsidence. Evidence indicates that the shore-line of deposition was near and occasionally within what is at present the Eureka section of the Little Hatchet Mountains. The centre of volcanism appears to have been close to the edge of the geosyncline, that is, north of the site of these mountains. G. S. S.

779. Conditions of Sedimentation and Sources of the Oriskany Sandstone as Indicated by Petrology. M. H. Stow. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 541–564.—Samples of the Oriskany Sandstone, exposed between Monroe Co., New York and Monroe Co., West Virginia, were collected and examined and are here described in detail.

The varied lithological characters of the Oriskany are discussed, and a description of these variations is given from ten districts.

Heavy mineral assemblages included the following individual species: zircon, tourmaline, rutile, garnet, hypersthene, kyanite, amphiboles and leucoxene. A tourmaline–rutile–leucoxene assemblage was characteristic of the Oriskany south of New York, and another, which was confined to New York, was garnet–hypersthene–kyanite–biotite–amphiboles. These two heavy mineral suites were quite distinct and suggest that: [a] the Oriskany sediments (south of New York) owed their origin solely from sedimentary formations, such as Silurian and Cambrian sandstones, and [b] in the New York area they were derived from crystalline rocks (the Adirondacks) in addition to material from sedimentary formations. G. S. S.

780. Geological Limitations to Oil Law. W. W. Porter II. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 565–573.—The geological factors which enter into the discussion on the relative merits of "rule of capture" and of sharing in the production according to acreage and location ("ownership in place") are outlined. These factors include

faulting, thinning out of sands over buried hills, unconformities, overlaps, variable porosity and permeability, and lenticularity. In general, adequate understanding of reservoir conditions is only approached in the case of pools of very simple structure and to apply methods suitable for those pools to the division of production from more complex types is hardly wise. Until our knowledge of reservoir conditions is sufficiently advanced to deal with the complex cases unitization and allocation of production are impracticable. It is pointed out that the rule of capture need not be synonymous with waste. S. E. C.

781. Oil Deposits in S.S.R. of Bashkir. D. M. Preda. *Monit. Petr. roum.*, 1938, **39**, 497–501.—Bashkir is a Soviet Republic on the W. slope of the Southern Urals. Its capital is Ufa, with 200,000 inhabitants. Oil is found near Sterlitamak, 100–120 km. south of Ufa, with the chief depot Ichimbevo, on the Byelaya River. Isolated peaks of some 1000 feet or more, called "Chikanes," rise from the plain. These are calcareous reefs of doubtful origin; but similar structures, buried under Permian rocks, contain oil.

Drilling under the Tzarist regime led to no practical result, but in 1928 systematic prospecting was renewed and the Ichimbevo field came into production in 1932. It is possible that other areas will be exploited later. Production rose from 4500 tons in 1932 to nearly 1 million tons in 1936, but the wells soon go dry and fresh ones are constantly being sunk.

The oil is found in Artinskian strata (the lowest Permian) underlying Kungurian sediments. The Artinskian surface is very uneven, and the oil is usually found in the highest points of it. The overlying Kungurian consists of thin shales over the Artinskian peaks, and thick beds of salt and gypsum, sometimes in anticlines, over the depressions.

Electrically-driven rotary drills have been used since 1935. Average depth of wells is 700–1000 metres but a few have been sunk beyond 1600 metres without going beyond the Artinskian, and without finding oil at great depths. Wells gush at first, and then pumping or gas-lifting has to be used, but yield falls off rapidly. When production falls below 4–15 tons per day the well is treated with HCl, which increases production by 6–10%. Wells are spaced at 100-metre intervals. Average pressure in them is 45 atmospheres.

The crude oil is the best in Russia, and gives a high yield of petrol. The gas content is very variable. Highly mineralized water is sometimes encountered. The dissolved salts are mainly chlorides of potassium and sodium, with some calcium and magnesium.

Drilling in other districts of Bashkir has so far been unproductive, but it is hoped to find oil in the Carboniferous. Some geologists think the Artinskian oil is of carboniferous origin. W. E. J. B.

Geophysics.

782 Application of Electrical Logging Methods to West Texas Problems. W. J. Gillingham and W. B. Steward. *Petrol. Engr*, April 1938, **9** (7), 52–55; May 1938, **9** (8), 84–92.—Resistivity curves have given good correlation of sand and shale formations in West Texas, and in spite of the gradational nature of these sediments can be carried over considerable distances. Electrical logging differentiates between formations even better than cable tool logs, and eliminates the personal factor. By this means the Rustler, Base of Salt, Yates Sand, and Top of Lime geological markers can be determined with ease over a distance of 50 ml. The electrofiltration effects are small and masked by electrochemical effects, for the muds usually used are saturated with salt. Hence the determination of porosity or permeability is very difficult and sometimes impossible, but can be achieved at times by using fresh muds.

Temperature surveys have been run and have detected and clearly outlined gas- and oil-bearing formations. Gas gives a cooling effect in both drilling and producing wells. Oil gives a smaller anomally. It is important to locate the base of the gas so that oil is not shut off or a very high gas/oil ratio obtained. The best results for gas are obtained after circulating from the bottom for 2 hr. Oil anomalies show up better some hours after circulation and with a lighter mud. The degree of cooling depends on too many factors to be used as a measure of the potential productivity. The ideal

conditions for determining the position of a gas horizon are that the well should be killed with mud and mud circulated. Wells can also be surveyed when filled with oil. By swabbing a well down and making the survey whilst it is filling, a very complete set of data is obtained since the temperature gradient curve is then obtained under dynamic conditions and the oil and gas pays stand out clearly.

Dale photoelectric surveys have been made for the detection of water flows. These are most successful on swabbing or pumping wells, for flowing wells have first to be killed, and the killing fluid, usually water, is forced into the formations irrespective of whether they are water-bearing or not. On lowering the fluid level for the survey the injected water is returned, giving a false idea of the position of water-bearing horizons. G. D. H.

783. Various Phases in Torsion Balance Work. K. W. Steinmann. *Oil Wkly*, 2.5.38, **89** (8), 19–23.—The use of the torsion balance is described in very simple terms, from the preliminary surveying for topographic corrections, the selection of the site for the erection of the instrument hut, the nature of the latter and of the torsion balance, and the taking of the records, to the interpretation of the results. G. D. H.

Drilling.

784. Several Benefits Gained from New Type Well Completion. T. P. Sanders. *Oil Gas J.*, 7.4.38, **36** (47), 39.—A new type of oil well has made its appearance in the Long Beach harbour area of the Wilmington field. This is the three-in-one well, which makes it possible to produce three zones simultaneously in one well without mixing the production from the various zones.

In drilling and equipping a three-zone producer 275 feet of surface pipe is cemented, an 11¾-in. water string is set on top of the Ranger zone at approx. 2370 feet and cemented. The well is then drilled to about 3890 feet to penetrate the three oil zones: Ranger, Upper and Lower Terminal.

A long liner is then made up with perforations opposite the oil zones and blank liners opposite the shale intervals between these zones. This liner is hung in the shoe of the 11¾-in. casing by means of a lead-seal liner hanger which packs off between liner and casing.

The blank sections are then cemented. A full string of 6⅝-in. casing is then run with a packer at the lower end which is set between the Ranger and the Upper Terminal in the blank section.

A full string of tubing is then run into the well with a packer which is set in the lower blank liner section between the Upper and Lower Terminal Zones. Circulating joints are set and these permit bringing in each of the zones by the circulating method. L. V. W. C.

785. Use of Drilling Time in Determining Completion Practices. M. David. *Oil Wkly*, 4.4.38, **89** (4), 39; *Oil Gas J.*, 31.3.38, **36** (46), 69.—The presence of porous zones and their thickness can be determined in rotary wells by noting the time required to drill a certain interval, that is, by noting the drilling time. Porous dolomitic limestone drills faster than impervious dolomitic limestone and hence the time factor can be utilized.

In the Goldsmith Pool, Texas, there is a close relationship between drilling time a well potential and the estimation of relative property values is made easier and more accurate by this method.

Drilling time also enables casing points, total depths, method of acidization and the placing of shots to be determined, and furnishes valuable information for plug back depths, selection of liner positions and pipe perforations.

Recording the drilling time should be an integral part of the information secured on rotary wells where it is applicable. L. V. W. C.

786. Orderly Development Characterizes K.M.A. Field. R. H. King. *Petrol Engr*, May 1938, **9** (8), 38.—The discovery and rapid development of the East Texas field has enabled the operators in the K.M.A. field, Wichita and Archer Counties, Texas,

to proceed with their development in an orderly manner. Recently drilled wells are better equipped, more advantageously finished and produce at higher rates than the early wells in this field. Improved engineering technique has definitely resulted in the increase in the rates of production, although geological differences and structural position of the producing formation account for a part of the difference.

Most wells are drilled by rotary to the top of the producing zone and cable tools or some sort of clean-out machine used for drilling-in.

Where rotary is used throughout, the mud fluid is replaced by oil or clear water, with oil used for the final cleaning. Most wells are shot or treated with acid. The amount of acid used is being reduced and the pressure applied increased to force the acid outwards through the small channels to enlarge them rather than the well bore.

Electrical logging has been introduced and gun perforating carried out.

Spacing of wells is on a 20-acre pattern. Gas/oil ratio is fairly uniform and is approximately 430 cu. ft. per barrel. L. V. W. C.

787. Setting Two New Depth Records. B. Mills. *Oil Wkly*, 25.4.38, **89** (7), 30.—A full description is given of the Continental Oil Company's well, Kern County, California which has broken the depth record by drilling to 15,004 ft. and the producing record by producing from, 13,100 feet. L. V. W. C.

788. Good Drilling Practice. Part I. J. Bayliss. *Oil Wkly*, 18.4.38, **89** (6), 30.—The author deals here with rig foundations, building the rig and rigging up, and indicates methods by which time and/or expense can be saved and efficiency increased in the drilling of wells. L. V. W. C.

789. Marine Drilling on the Gulf Coast. I. W. Alcorn. *Oil Wkly*, 4.4.38, **89** (4), 48.—A description is given of typical drilling locations in submerged areas including marshland, inland lakes and open gulf, and of operating difficulties that are encountered in such operations. The author comments on foundations and equipment applicable to the various types of drilling sites, including marine equipment such as house-boats, barges, and tugs, the damage to structures by heavy storms and the difficulties experienced in changing crews under such conditions. L. V. W. C.

790. New Methods in Fishing for Tubing. J. Chastain. *Oil Wkly*, 11.4.38, **89** (5), 36.—New methods have been devised for fishing for stuck tubing or tubing catchers.

In one particular instance the well was 6486 feet deep with a tubing catcher set at 5200 feet, and due to the pump sticking it became necessary to pull the tubing string to recover the pump. The tubing did not extend sufficiently high to enable the elevators to latch under the coupling and a " pick up " nipple had to be screwed into the top joint. This nipple was not tightened in the coupling and when the tubing was picked up the threads stripped and the 648 feet of tubing dropped about five feet. The tubing catcher caught the bottom and the tubing head caught the top of the tubing and the excessive weight caused the catcher to hang so that it could not be pulled.

An overshot was run and a portion of the tubing was unscrewed. A " Bulldog Overshot " was then run to catch hold of the remaining tubing. This overshot was hollow and allowed tools up to 2¼ in. to pass through, and a cutter was run. The tubing was run and after it was run the blank overshot was replaced by rotary automatic jars, a safety joint and a releasing socket. The tubing was then jarred exerting a jolt on the catcher of 40,000 lb. The catcher was disengaged in 1 hour and 20 minutes and removed from the hole. L. V. W. C.

791. Drilling Patents. J. Hoffass. U.S.P. 2,115,166, 26.4.38. Core catcher.

G. Malmgren. U.S.P. 2,116,120, 3.5.38. Bore-hole surveying apparatus.

F. F. Dickey and H. S. Cole. U.S.P. 2,116,236, 3.5.38. A method of setting casing in a well by welding the joints.

J. C. Hewitt. U.S.P. 2,116,350, 3.5.38. Well surveying apparatus comprising a buoyantly floating compass, a photographic element in focus with the compass and means of illuminating a lower submerged surface of the compass.

F. G. McCann. U.S.P. 2,116,359, 3.5.38. Well boring apparatus comprising a string of casing with a tubular shaft revolvably mounted inside and a spiral secured in relation to the lower end of the shaft.

C. N. O'Leary and O. F. King. U.S.P. 2,116,408, 3.5.38. Floating cementing equipment with an axial flow passage through the casing shoe to cause turbulent flow through the shoe.

D. Hanes. U.S.P. 2,117,318, 17.5.38. Casing float collar.

B. L. Peterson. U.S.P. 2,117,357, 17.5.38. Tool joint for drill pipe which allows for flexing of the joint at least equal to the amount of flexing occurring in the pipe sections under operating conditions.

R. C. Baker. U.S.P. 2,117,533, 17.5.38. Drill collar float valve for drilling strings.

R. C. Baker. U.S.P. 2,117,534, 17.5.38. Well cementing device.

R. C. Baker and C. E. Burt. U.S.P. 2,117,535, 17.5.38. Wire line operated cement retainer and bridge plug.

R. C. Baker and O. A. Mellin. U.S.P. 2,117,536, 17.5.38. Valve structure for well casings and tubing.

R. C. Baker. U.S.P. 2,117,537, 17.5.38. Guide and wash down shoe for well casing.

R. C. Baker. U.S.P. 2,117,538, 17.5.38. Cement basket.

C. C. Brown. U.S.P. 2,117,836, 17.5.38. Combined back pressure valve and wall scraper.

C. O. McDowell. U.S.P. 2,117,898, 17.5.38. Apparatus for cementing consisting of a reservoir for a quantity of cementitious material with a discharge opening in the reservoir and means for retaining the valve closed or open by pressure exerted by the casing of the well to be cemented. L. V. W. C.

Production.

792. Pressure Production Relationships in the East Texas Field. S. E. Buckley. *Oil Gas J.*, 7.4.38, **36** (47), 34; *Oil Wkly*, 11.4.38, **89** (5), 19.—The author does not deal with the mathematical aspect of the mechanism of water encroachment nor with detailed calculations of the reservoir pressure decline but gives an analysis of certain readily apparent generalizations concerning the relation between reservoir pressure and rate of withdrawal.

He adjusts Hurst's equation to fit the particular conditions encountered in East Texas and calculates the reservoir pressure of this field from the withdrawals throughout the history of the field. Graphs are given to show the observed and calculated pressures and the rate of fluid withdrawal as measured in the reservoir and the accuracy with which it is possible to calculate the pressure throughout the irregular production history of the field justifies the concept of the mechanism of the water drive. In addition it demonstrates the precision with which it is possible to determine the strength of the water drive and the validity of the equation as a basis both for extrapolation into the future and for the portrayal of the possible behaviour of the reservoir under rate of withdrawal different from those which have actually occurred. L. V. W. C.

793. Much Progress in the Chemical Treatment of California Oil Wells. Anon. *Oil Wkly*, 18.4.38, **89** (6), 24.—Although the Permian Limestone deposits are absent in many of the Mid Continent Wells, operators have made surprising gains by chemical treatment of various forms to new and old wells.

Chemical treatment of wells in the siliceous formations of the Pacific coast has been concerned with the removal of mud sheaths, and the removal of wax, asphalt and water scale.

Chemical inertness of the mud solids makes mud cake removal unsatisfactory. To offset this, various operators are alkalizing the mud stream with calcium carbonate. The mud cake deposited by such a mixture is reactable with acid.

In old wells where the mud cake is oil soaked and penetration may be difficult, wetting agents are incorporated in the chemical solution. Another method depends on the generation of heat along with the chemical reaction directed to the dissolution of the mud sheath.

Wax and asphalts have been removed by the use of stove oil and organic solvents.

Water scales of the carbonate type have responded to inhibited hydrochloric acid.

The chemicals used for the various types of treatment may be grouped under the headings "acid," "neutral," and "alkaline." L. V. W. C.

794. Gas and Air Repressuring. E. H. Tollefson. *Oil Wkly*, 25.4.38, **89** (7), 64.—It is now the general practice of practically all operators in West Virginia and S.E. Ohio to repressure their oil properties, using gas and, in a few cases, air as a repressuring medium.

The most common method is the gas drive or re-cycling method. Air is seldom used because of the excessive operating expense.

All available data on a pool should be studied and a preliminary test carried out with a small portable or temporary compressor unit. This test should be made very carefully and all information collected to determine the pressure conditions, the behaviour of the circulating medium and the percentage of increase in production. A permanent repressuring plant can be designed on the basis of these data.

Channelling results from pushing the field too hard by trying to circulate the gas too quickly. Gas should be circulated slowly until the full effects of the repressuring at the original rate of input have been reached, when the gas input can be increased. Where channelling has developed it becomes necessary to either back pressure the well affected or change the pressure well.

Other problems are dealt with. The prospects for future developments in the method and extent of repressuring operations in the West Virginian and Ohio fields are stated to be dependent on the price of crude oil in the eastern markets.

L. V. W. C.

795. Repressuring of German Oil-fields. O. Deicher. *Oel u. Kohle*, 1938, **14**, 258.—The application of existing methods to the Nienhagen, Oberg, and Berkhopen fields is described. P. G. H.

796. Well Treatment after Perforating. B. Barkis. *Oil Gas J.*, 31.3.38, **36** (46), 176.—The only factor influencing perforating that can usually be controlled is the kind and amount of fluid in the hole. In general the fluid is kept from 500 to 1500 feet lower than the expected fluid level in order to let the incoming fluid clean the smaller perforations.

Where casing has been cemented through a productive zone and is to be perforated, the natural zone characteristics, including the type of oil, amount of gas, formation pressure, permeability, porosity, grain size, shear and water content, may all be known.

Remedial measures taken to stimulate or bring back production in an old producing well will generally have to overcome adverse sub-surface conditions. The method of originally completing the well will indicate whether mud and other contaminating material has been completely removed from the slot openings and extending externally into the formation where the natural sand conditions obtain.

Clogging of the pores may result from the movement of silt into them and may be aggravated by the waxing or sludging effect of certain types of oils.

Well treatment methods are primarily of the mechanical, hydraulic and chemical type. These methods are given in some detail. L. V. W. C.

797. Factors in Design of a Salt Water Gathering System. J. E. Bailey. *Oil Gas J.*, 31.3.38, **36** (46), 179.—Two minor problems in transportation of salt water produced from oil and gas wells exist. One is the formation of a precipitate scale that clings to and clogs up the pipe, and the second is the formation of a corrosive scale by the action of the salt water on the pipe.

Experience has shown that the deeper the hole the more salt the water and the higher the temperature, the warmer the water the greater the solubility and hence the larger the amount of mineral matter held in solution. Increase in pressure increases the solubility. A reduction of temperature and pressure in a separating tank allows solids to be precipitated by a reduction in solubility.

The brine should not be allowed to become oxidized and air should not come into contact with the brine anywhere in the system. If iron, manganese and sulphur compounds in the salt water are exposed to air, precipitates are formed and the brine becomes acidic. This increases the corrosive qualities of the water.

If the materials will not stay in solution in the water during transportation, several methods of coping with the situation are available.

The selection of the materials to be used in the manufacture of the necessary plant and the design of the gathering system are given in detail. L. V. W. C.

798. Controlling Gas-Oil Ratios in West Texas. Anon. *Oil Gas J.*, 14.4.38, **36** (48), 82.—Probably the most important operating problem in the Permian Basin of West Texas is the proper control of gas–oil ratios. Injection of the gas limit factor in the allocation formula of most West Texas fields definitely presents the gas–oil ratios as a function of daily allowables, etc. Unfortunately uniform gas withdrawals are not always made.

The proper and easiest time to establish efficient producing ratios is during the completion period of each well, by accurately determining the gas–oil contact and setting the producing string of casing below that point and above the oilbearing zones. The most important detail is the accurate selection of the oil–gas contact, whether the work is completion or remedial. The electrical temperature survey has been found highly successful in this work. L. V. W. C.

799. Accurate Sand Measurements Aid in Establishing Method Recovery. H. M. Ryder and D. T. May. *Oil Gas J.*, 21.4.38, **36** (49), 47.—The important measurements on an oil sand are permeability, porosity and saturation, and of these it is suggested that saturation is the most important for many purposes. Permeability and porosity are reasonably permanent but saturation is not. In order to obtain accurate results the pieces of sand upon which the saturation test is to be made should be in essentially the same condition in the apparatus as they were in the sand body. The methods in the laboratory should, in addition, be such that all the oil contained in the sand samples can be accurately measured. The effect of water pressure may be serious on the core since pressures equivalent to 10,000 lb. per sq. in. may be applied to an intake well to move oil to a producing well 150 ft. distant.

In order to obtain sand samples an inexpensive and very practical method has been developed. An ordinary cable bit is dressed quite sharp, the two faces at the cutting edge forming an angle of less than 90°. A sand pump is used to keep the hole clear and when the bit is dropped about 25 feet to the bottom and allowed to drill for a few minutes in the ordinary manner large sand samples will be produced. The water level in the hole during this operation is very small, only sufficient to keep any free oil in the hole above the chips so cut. L. V. W. C.

800. Standardization of Surface Control Equipment. M. T. Works. *Oil Gas J.*, 14.4.38, **36** (48), 104.—Standardization of drilling control hook-ups is being considered by operators in Texas and elsewhere. Such standardization would require that a definite casing programme be outlined in advance even on wildcat locations. The particular make of blowout preventers, casingheads and tubing heads to be used must be decided upon, and manufacturers will be able to supply the dimensions required without the necessity for drawings. L. V. W. C.

801. Economic Rehabilitation of Stripper Wells. T. H. Rogers. *Petrol. Engr*, May 1938, **9** (8), 33.—The author gives details of a two-year programme carried out by a company in the California district for the rehabilitation of stripper wells. Many useful facts are given which may be of value to those faced with the problem of rehabilitating or abandoning their properties. L. V. W. C.

802. Back-Crank Pumping and Rod Line Problems. J. C. Slonneger. *Oil Gas J.*, 28.4.38, **36** (50), 57.—The selection of pumping equipment must begin with the pump at the bottom of the well. Depth and quantity of fluid to be lifted must be known, and then the time in which this quantity of fluid is to be pumped.

The jack size can be determined from the calculated polish-rod load and the jack ratio can then be made. The higher the ratio the better the mechanical advantage of the sucker rods to return the rod-line rods.

Having chosen the jack ratio the polish-rod load may be transferred to the rod line at the jack by multiplying the polish-rod load by the jack ratio.

Rod-line inertia, maximum rod-line pull and torque can then be determined by the use of formula given. Various well hook-ups are considered as well as the effect of speed, the pounding of fluid, prime movers and counterbalancing. L. V. W. C.

803. Recent Developments in Water Flooding. A. C. Simmons. *Oil Wkly*, 25.4.38, **89** (7), 19.—Although the principles of water-flooding oilsands are as old as the production of petroleum, carefully controlled pattern pressure flooding is of comparatively recent origin.

The author presents a water-flooding project, including cost of development, a discussion and description of the mechanical equipment, the application of water and oil production results up to date.

Data are included to indicate the similarity of Bradford Field five-spot decline curves and the desirability of maintaining high water pressures, high rates of water input, and illustrates the advantage derived from various innovations of automatic equipment and mechanical protective devices. L. V. W. C.

804. New Method of Cleaning Sand from Oklahoma City Wells. G. S. Schuhmacher. *Oil Gas J.*, 7.4.38, **36** (47), 32.—As a result of the failure of normal methods of cleaning sand from the Oklahoma City Wells a new method has been developed.

Gas lift was found satisfactory so long as the bottom-hole pressure was high enough to support the column of oil heavily laden with sand. When the reservoir pressure fell too low for this an artificial bottom-hole pressure was built up by means of a centrifugal pump. This type of pump will handle sand or other solids in suspension.

The average time taken for each of 40 centrifugal pump clean-out jobs was 48 hours. L. V. W. C.

805. Production Patents. J. E. Gosline. U.S.P. 2,115,018, 26.4.38. Bottom-hole-pressure recording device.

G. W. McFarlane. U.S.P. 2,115,205, 26.4.38. Well screen.

E. W. Patterson. U.S.P. 2,116,465, 3.5.38. Method and means of perforating oil-well casing.

H. E. Harr. U.S.P. 2,116,572, 10.5.38. Casing perforator.

G. D. Johnson. U.S.P. 2,116,898, 10.5.38. Expansible casing cutter.

J. W. McClatchie, G. D. Johnson, and C. A. Theis. U.S.P. 2,116,903, 10.5.38. Casing cutter of the expanding type.

C. P. Wilson. U.S.P. 2,117,050, 10.5.38. Inside casing cutter.

J. G. Dyer. U.S.P. 2,117,277, 17.5.38. Method of perforating casing in a well by setting a whipstock in the casing and milling a portion of the casing away at the same time as the fluid is circulating through the cutter.

R. W. Barrett. U.S.P. 2,117,594, 17.5.38. Inside casing cutter.

G. W. Bowen. U.S.P. 2,117,599, 17.5.38. Inside casing cutter. L. V. W. C.

Transport and Storage

806. Cathodic Protection of a Large Gas Line Passing Through a Steel Casing Filled with Salt Water and Mud. G. Corfield. *Petrol. Engr*, May 1938, **9** (8), 78.—A 26-inch natural gas line from Kettleman Hills to Long Beach, California, was carried under a paved and heavily travelled highway in a reclaimed area, consisting of salt water, impregnated sand and dredged mud. A 30-in. casing was first installed at 13 ft. depth, heavily greased on the inside, and the pipe sections inserted, welded and pushed through, the pipe being heavily greased and protected with layers of fabric wrapping and bituminous hot coating. Particular corrosion hazards were present owing to the vicinity of an electric track, to the connection of the 26-in. pipe to other lines in the vicinity, acting as a stray current gathering system, to the possibility of abrasions and imperfectly protected welds owing to the construction difficulties and to the potential difference between the pipe in the casing, together with the risers and the rest of the line. The first step was to bond the pipe to the electric track, using an electrolysis switch to interrupt the current at times of reversal when the track became positive owing to the excessive surges of current when the electric cars were stopped and restarted at this point. A further step was to insulate a short section under and on both sides of the highway from the rest of the line, so that the section would be sufficiently lowered in potential by the influence of the electric railway to receive cathodic protection. It was doubted whether the inner pipe would be sufficiently protected owing to the shielding effect of the outer casing, but tests with buried pipe fittings showed no reduction in the protection. The installation in question is considered to be adequately protected against the very severe electrolysis and corrosion hazards present. C. L. G.

Crude Petroleum.

807. Bureau of Mines Analysis of Pennsylvania and New York Crude Oils. Anon. *Petrol. Engr*, May 1938, **9** (8), 62.—A summary has recently been made by the Bureau of Mines of analyses of 58 samples of crude oils taken from the oilfields of Pennsylvania and New York over the last 19 years. Production from the two fields is very similar, a typical crude from Bradford Field, McKean County, Pa, giving the following figures: sp. gr. 0·800, sulphur 0·11%, Visc.S.U. at 100° F. 39 secs. On Hempel distillation this crude gave the following yields of products: Light gasoline 11·2%, total gasoline and naphtha 34·2%, kerosine 17·0%, Gas oil 9·6%, non-viscous and medium lubricating distillates, 10·7% and 5·2% respectively, and residuum 21·3%. C. L. G.

808. Composition of Roumanian Crude (V–VIII)—Methyl-substituted Naphthalenes. T. Coscuig. *Petrol. Z.*, 20.4.38, **34** (16), 3; 27.4.38, **34** (17), 4; 18.5.38, **34** (20), 1.—Mixed α and β *methylnaphthalenes* were isolated as picrates from a narrow cut (120–122° C. at 20 mm.). An unsuccessful attempt was made to separate the isomers by fract. crystallization of the picrates, only the β isomer being obtained pure. A similar recrystallization of known mixtures of pure α and β Me-naphthalenes also gave only pure β and a mixture of α and β; the method fails because slight decomposition of the picrates occurs during repeated recrystallization.

Of the ten isomers of *dimethylnaphthalene* ($C_{12}H_{12}$) the 2 : 6 isomer was obtained as such from the 130–132° C. (20 mm.) cut, and from the 140–142° C. cut, 1 : 6, 1 : 3, and 1 : 7 isomers were isolated as picrates.

2 : 3 : 6 trimethylnaphthalene and a $C_{14}H_{16}$ hydrocarbon were isolated, both impure, from the 150–152° C. and 160–162° C. fractions respectively. P. G. H.

809. Desalting Crudes in Refinery Presents Two Problems. Anon. *Oil Gas J.*, 31.3.38, **36** (46), 140.—According to C. H. Roberts and R. W. Stenzel, the determination of salts in crude oil comprises two entirely separate problems: (1) complete extraction from the oil, by suitable means, of the salt contained therein, and (2) estimation, in the aqueous extract, of the kinds and quantities of the various sub-

stances present. The first problem is by far the more difficult and has received greater attention, firstly owing to the difficulties of extraction processes in heterogeneous systems and secondly owing to the presence in crude oils of naturally occurring emulsifying agents, hindering solution of salts in the extraction medium and impending complete separation and recovery for subsequent analysis. A report on the further discussion of the problems with summaries of methods of extraction and analysis is available from Petroleum Rectifying Co. of California. R. A. E.

810. Patents on Crude Oil. W. Tiddy. U.S.P. 2,113,635, 12.4.38. Method of distillation of crude petroleum.

I. M. Colbeth. U.S.P. 2,114,651, 19.4.38. Separation of petroleum emulsions of the oil/water type using as demulsifying agent polymerized rape oil, corn oil or castor oil. W. S. E. C.

Gas.

811. Chemical Utilization of Gaseous Hydrocarbons—Part 2. Chemicals from Natural Gas. B. Kwal. *Petrol. Engr*, May 1938, **9** (8), 72.—Reference is made to a very large number of methods of preparing chemical products from the paraffin hydrocarbons in natural gas by heat treatment in the presence of catalysts, and by thermal or photochemical halogenation, etc. The oxidation of methane and its derivatives according to the hydroxylation and peroxide theories are discussed, both these reactions being considered to take place in all oxidations of gaseous hydrocarbons. Reference is also made to the products formed by the reaction of sulphuric acid and nitric acid on paraffins, to the reaction between methane and ammonia at high temperatures giving hydrocyanic acid, and to the possible use of methane for the reduction of magnetite and limonite. C. L. G.

812. Patents on Gas. D. Gardner. E.P. 483,406, 20.4.38. Production of reactive hydrogen from lithium hydride.

I.G. Farbenindustrie A.-G. E.P. 483,426, 20.4.38. Production by the conversion of solid, gaseous or liquid fuels by means of steam. W. S. E. C.

Cracking.

813. Production of Liquid Fuels by Chemical Methods. E. Galle. *Petrol. Z.*, 11.5.38, **34** (19), 1.—A lecture describing methods of increasing yield of fuel from petroleum by cracking and hydrogenation, and from non-petroleum products (*e.g.* coal) by hydrogenation and by the Fischer-Tropsch Kogasin synthesis. P. G. H.

Hydrogenation.

814. Patents on Hydrogenation. H. E. Potts. E.P. 484,127, 2.5.38. Hydrogenation of liquid or solid carbonaceous substances using tungsten sulphide as catalyst.

C. Krauch and M. Pier. U.S.P. 2,115,336, 26.4.38. Hydrogenation of solid or liquid fuels into motor spirit at 300–700° C. under at least 20 atm. pressure in the presence of a catalyst containing combined sulphur generated in the reaction from a metal oxide (from group 6 of the periodic system) which is immune to poisoning by sulphur and added free sulphur. W. S. E. C.

See also Abstract No. 813.

Polymerization.

815. World's Largest Thermal Polymerization Unit. S. D. Turner and M. W. Mayer. *World Petrol.*, April 1938, **9** (4), 44.—A thermal polymerization unit at a Baytown refinery has been operating since June 1937 and produces nearly 3500 brl. of gasoline a day from 10,000 brl. of feed stock consisting of 4000 brl. of butane and butylene recovered from refinery operations and 6000 brl. of butane transported by pipe-line

in a casinghead blend from the E. Texas field. In the Unitary process employed propanes and butanes are cracked and polymerized simultaneously in a coil at about 1025° F. and 1800 lb. per sq. in. pressure at the coil outlet. The reaction products, after heat exchange and cooling with heavy quench oil, pass to a primary rectification tower held at 400 lb. from which butanes and lighter fractions are taken off overhead and a partially debutanized bottom stream withdrawn. The latter is separated into a light gasoline (230/250° F. E.Pt.), a heavy naphtha (400° F. E.Pt.) and a mixture of quench oil and heavy tarry bottoms in an atmospheric gasoline tower. The former, combined with fresh feed, goes to the furnace feed stripping tower, where the residual gases are removed and passed to the refinery fuel gas system. The light polymer gasoline produced has an I.B.Pt. of 90° F., distils 95% to 212° F. and an E.Pt. of 245° F., a Reid V.P. of 13 lb./sq. in. and an O.N. of 77·5 (blending value 87·0). It is of good colour and colour stability, free from mercaptans and elementary sulphur and thus requires no refining. The heavy polymer gasoline has an I.B.Pt. of 195° F. and F.B.Pt. of 480° F., with a Reid V.P. of 2·3 lb. and an O.N. of 75. It is of unsatisfactory colour and is mixed with cracked naphtha, acid treated, redistilled to a 6% bottom and doctor treated. C. L. G.

Refining and Refinery Plant.

816. Removal of Hydrogen Sulphide from Refinery Gases by Girbotol Process. W. R. Wood and B. D. Storrs. *Oil Gas J.*, 26.5.38, **37** (2), 47.—The Girbotol process for the removal of H_2S and other weak acidic gases from gas mixtures involves washing the gas with an aqueous solution of an amine, which reacts with such materials forming a compound from which the amines can be recovered by heat. The sour gas is passed to the reactivator, where it is heated by a reboiler, the H_2S being expelled. Mechanical and vaporization losses of the amines used are very small. They are stable and not corrosive, while their alkalinity protects against the corrosive effect of the H_2S. Various amines are available for different purification purposes. Four Girbotol plants are completed or under construction for removing H_2S from refinery gases and seven for purifying natural gas, and five for the separation of CO_2 from the hydrogen produced by reacting hydrocarbon gas with steam. The efficiency of H_2S removal is better than 99%, even with concentrations up to 3000 grams per 100 cu. ft. In the case of natural gas, dehydration can also be effected by substituting diethylene glycol for water as the amine solvent. The process should be of value to hydrogenation plants for the removal of both CO_2 and H_2S, and may also be used for the recovery of CO_2 in dry ice plants, the recovery of H_2S, the purification of gas engine fuel and the production of inert atmospheres. C. L. G.

817. Use of Sodium Phenolate for Hydrogen Sulphide Removal. G. M. Carvlin. *Oil Gas J.*, 26.5.38, **37** (2), 56.—The removal of H_2S from refinery gas is of importance from the point of view of the utilization of the gas, the reduction of corrosion and the availability of a basic material for the manufacture of H_2SO_4. The Seaboard process originally developed for this purpose, employing sodium carbonate solution, suffered from the disadvantages of delivering H_2S mixed with large quantities of air and required circulation of large volumes of solution, resulting in high operating cost. The modern process involves " hot-actification " in which the various absorbents—sodium carbonate, potassium borate, magnesium hydroxide and sodium phenolate—can be regenerated by boiling and the H_2S recovered practically pure.

Further processes are in use for the purification of manufactured gas, using alkaline solutions containing iron, nickel and arsenic salts, in which the foul solution is regenerated by contact with air-liberating sulphur in the form of a froth which can be converted to a 50% paste and is marketed as a germicidal spray.

From a theoretical basis, which is fully discussed, the use of sodium phenolate is preferred owing to the ease of regeneration, a two-stage process being advisable when large quantities of H_2S are present or if complete removal is necessary.

A description with flow sheets and operating details of single-stage and two-stage sodium phenolate plants is given. The method and cost of producing sulphuric acid from the H_2S removed is outlined. A purification type contact plant is used in which the H_2S is burnt in a refractory lined burner and the combustion products, mixed with

the necessary amount of air passed through a waste heat boiler to a cooling tower, using water or weak acid. Mist is removed in a Cottrell precipitator or coke filter and the gases scrubbed with 98% H_2SO_4. After heat exchange, the hot gases pass through Va. or Pt. contact masses and the SO_3 formed is absorbed in 98% H_2SO_4, from which weaker acid or oleum is obtained as required. The conversion efficiency of the H_2S is about 95%. The cost of producing 66% Be acid from a typical refinery gas is given as \$3·25 per ton, without allowing credit for the purified gas or the reduction of maintenance or for the elimination of atmospheric pollution. The investment for the purification and acid plant may be amortized in two years.

C. L. C.

818. Acid and Reactive Colloid for Water Treatment. L. D. Betz. *Nat. Petrol. News*, 6.4.38, **30** (14), R. 167.—The various methods available for the treatment of boiler feed and cooler water are discussed from a chemical and economic standpoint. It is pointed out that the choice of a particular method must always be circumscribed by considerations of the properties of the water, degree of softening required, plant available, etc. A strong plea is made for the partial neutralization of alkaline waters with sulphuric acid and subsequent treatment with reactive organic colloids for the purpose of preventing the caking of precipitated crystalline calcium sulphate. It is claimed that the method is efficient when properly controlled, cheap to maintain and necessitates a minimum initial outlay for plant. H. G.

Chemistry and Physics of Petroleum.

819. Catalytic Oxidation of Hydrocarbons in Vapour Phase. W. v. Piotrowski and J. Winkler. *Petrol Z.*, 20.4.38, **34** (16), 1.—Short summary of work by "Galicja A–G" of Poland. A special mixture of hydrocarbons (b. pt. 170–250° C.), preheated to 150° C., is atomized with air at 300° C., and proceeds to a reaction chamber (containing a catalyst) where oxidation occurs. Practically no CO or CO_2 are formed. The issuing gases are freed from resinous and asphaltic constituents by rectification and are then cooled and condensed. By refractionation three liquid fractions, varying in b. pt. between 50° C. and 250° C., and a solid resinous residue are obtained. The products contain unsaturated and aromatic hydrocarbons, aldehydes and ketones (both sat. and unsat.), lactones, alcohols, and a small proportion of carboxylic acids and phenols.

It is stated that the cuts (suitably selected) may be used as (1) substitutes for mercaptans as "warning" agents in gases, (2) de-naturants for alcohol, (3) as removers of naphthalene from town-gas by spraying into the main; in this use, formation of gums and resins is stated to be inhibited. P. G. H.

820. Catalytic Hydrogenation of Octenes to Octanes. Anon. *Oil Gas J.*, 26.5.1938, **37** (2), 50.—A description is given of the operation of a catalytic hydrogenation process for the conversion of mixed octenes prepared by the sulphuric acid polymerization of butylenes, to octanes. From thermodynamic considerations and practical tests a hydrogenation temperature of 180/190° C. and a gauge pressure of 1 to 4 atmospheres is preferred. Below 180° C. the rate of reaction is low and the formation of nickel carbonyl likely, deactivating the catalyst. Higher temperatures increase the decomposition of the octene fraction components, lowering the yield and increasing the consumption of hydrogen and producing free carbon which deposits on the catalyst. The catalyst is prepared by decomposing hydrated nickel nitrate impregnated in porcelain to the oxide and reducing it to the metal in hydrogen. It is maintained in a hydrogen atmosphere when not in use to prevent oxidation. The catalyst is permanently deactivated by sulphur, so that the butylenes require careful desulphurization. The catalyst after it has lost its ability to promote hydrogenation can still be used for desulphurization of the feed. In the plant described 1000 gal. of finished *iso*-octane are produced per lb. of nickel catalyst. The hydrogen used contains 15% methane and nitrogen which are inert in this process. A 10/15% excess is used in order to increase the rate of conversion and decrease the volume of catalyst necessary. Hydrogen is conserved by using a two-stage counter-current flow system or by direct recycling of residue gas through a single-stage converter, the former giving a 95%

utilization of hydrogen and the latter 85/90%. Operating data from laboratory tests of the two methods are quoted. The catalyst is reactivated by purging with hydrogen, oxidizing with air and finally reducing with hydrogen. The activity declines after each reactivation, but its total life is increased by 150% after 2 to 4 reactivations.

Corrosion of the equipment is negligible, and owing to the low temperatures and pressures used, no special alloys or materials are required. The primary point of control of the finished product is the degree of unsaturation. A feature in some of the plants is the use of a catalyst tube for the hydrogen feed to convert any trace of CO to CH_4 and H_2O. The average yield during 22 months of operation is 103·1% of finished octanes by volume on the octene feed, as compared with the theoretical yield of *iso*-octane of 105·5% by volume of di-*iso*butylene. The properties of finished octanes are tabulated in comparison with those of technical *iso*-octane. C. L. G.

821. Influence of Temperature and Pressure on the Volume and Refractive Index of Benzene. R. E. Gibson and J. F. Kincaid. *J. Amer. chem. Soc.*, 1938, **60** (3), 511–518.—The authors have measured the compression of benzene at pressures up to 1250 bars and at temperatures ranging from 25° C. to 65° C.

The data were well represented by an equation of the form proposed by Tait and the constant C in this equation was independent of the temperature.

By matching the refractive indices of benzene under different conditions against those of optical glasses the authors have been able to estimate the change of refractive index with pressure.

The results confirm the empirical worth of the Eykman specific refraction formula and show that with this formula, the compressibility of benzene may be computed from refractive index pressure measurements almost as accurately as it may be measured directly. W. E. J. B.

822. Isomerization Accompanying Alkylation: Alkylation of Benzene with *iso*-Propylethylene in the Presence of Sulphuric Acid. V. N. Ipatieff, H. Pines and L. Schmerling. *J. Amer. chem. Soc.*, 1938, **60** (2), 353–354.—In the present investigations it was found that complete isomerization of the *iso*propylethylene occurs at 0° C. during the alkylation of benzene using 96% sulphuric acid as catalyst. The alkylation product formed is therefore *t*-amyl benzene and not 2-methyl-3-phenyl butane. The same product was also obtained by the alkylation of benzene with a mixture of trimethylethylene and unsymmetrical methyl ethylethylene. That the two amyl benzenes were identical was shown by the fact that both yielded the same mono- and diacetamino-derivatives. These were proved to be the same as derivatives of pure *t*-amyl benzene. W. E. J. B.

823. Kinetics of the Catalysed Polymerization of Styrene. Part 1. Experimental Methods and Some General Features of Stannic Chloride Catalysis. G. Williams. *J. chem. Soc.*, Feb. 1938, 246–253.—The polymerization of styrene, catalysed by pure stannic chloride, has been examined in carbon tetrachloride solution at 25–45° C. The process can be followed by quantitative bromination of the residual monomer present in a polymerizing mixture. The styrene disappearing during polymerization is shown, by quantitative precipitation of the polymer, to be equivalent to the polystyrene formed (mean molecular weight 1200–2700). Both polymer size, which usually remains constant through the course of a given reaction, and polymerization rate are more sensitive to change in concentration of styrene than of catalyst. The reactions have induction periods and, over a threefold concentration range, the maximum rate is approximately proportional to the concentration of catalyst.

The rate of polymerization is reproducible with freshly distilled styrene and is not affected by the addition of benzoyl peroxide. The polymerization of styrene, which has been kept for some time and contains peroxides, is retarded in its early stages. W. E. J. B.

824. Modified Grignard Reaction in the Synthesis of Hydrocarbons. J. W. H. Oldham and A. R. Ubbelohde. *J. chem. Soc.*, Feb. 1938, 201–206.—Investigations of the

products of reaction of butyl, octyl, nonyl, undecyl, dodecyl, tetradecyl, hexadecyl, octadecyl and benzyl halides with magnesium in ether shows that the three reactions

(1) formation of the Grignard reagent $RI + Mg = R{\cdot}MgI$
(2) Wurtz reaction $2RI + Mg = R_2 + MgI_2$
(3) disproportionation $2RI + Mg = RH + R'H + MgI_2$

take place concurrently. The extent to which each reaction takes place depends on the halogen and on the alkyl radical. Repeated addition of iodine, followed by magnesium, leads to yields of 65% or more of the long-chain paraffins R_2. The same method of synthesis is even more successful in the case of benzyl-halides. Experimental evidence on the mechanisms of the various reactions is discussed, and an improved method of purifying long-chain paraffins is described. W. E. J. B.

825. Importance of Polymerization Processes in Gum Formation in Gasolines. G. R. Schultze. *Oel u. Kohle*, 1938, **14**, 113–117.—Polymerization plays an important part in gum formation.

Peroxides have been considered as a primary product in the formation of gum but it is known that polymerization processes can take place in the absence of air or of peroxide formation.

In this connection the polymerization of pure *cyclo*pentadiene has been studied. This polymerizes to di*cyclo*pentadiene, which in its turn decomposes to the monomer at higher temperatures.

Since the reaction $2C_5H_6 \longrightarrow C_{10}H_{12}$ proceeds in the gas phase with reduction in volume it can be followed by manometric observations.

The starting material for these experiments was technical di*cyclo*pentadiene, from which the pure monomer was prepared by distillation. The pure dimer was obtained by polymerization of the monomer. The apparatus and method used are described in detail.

The synthesis and decomposition of the dimer were investigated over a pressure range 180–510 mm. Hg and a temperature range 132–182° C. Using the van t'Hoff temperature coefficients, the heat of activation for the polymerization was found to be 16,900 cal. $\pm$ 3% and for the depolymerization 37,000 cal. $\pm$ 5%. These reactions can be expressed by the Arrhenius equations

Polymerization

$$K = 6{\cdot}0 \times 10^6 e - \frac{16900}{RT}\left[\frac{\text{litre}}{\text{Mol. sec.}}\right]$$

Depolymerization

$$K = 2{\cdot}0 \times 10^{11} e - \frac{37000}{RT}\left[\frac{1}{\text{sec.}}\right]$$

Both reactions are unaffected by added N_2, steam or air.

All diolefines are important from the viewpoint of gum formation, since they react either with themselves or other substances.

A table shows that gum tests depending on volatilization do not show the presence of *cyclo*pentadiene except at high concentrations, as it tends to evaporate with the light fractions. Thus a test carried out in a closed vessel is a necessity if the effect of volatile gum formers is to be indicated.

The author concludes that the apparently anomalous results of different gum tests can in many cases be explained if the volatility of the gum-forming compounds is taken into account. D. L. S.

826. Reaction of *cyclo*Paraffins with Aromatic Hydrocarbons: De*cyclo*alkylation. A. V. Grosse and V. N. Ipatieff. *J. org. Chem.*, 1937, **2** (5), 447.—A catalytic reaction between aromatic hydrocarbons and *cyclo*paraffins is described. The reaction consists in the cleavage of the *cyclo*paraffin ring and alkylation of the aromatic hydrocarbon, and has been called "decyclo*alkylation*" by the authors. Three reactions of this type are reported, namely (*a*) *cyclo*propane and benzene, (*b*) methyl*cyclo*butene and benzene, (*c*) *cyclo*pentane and benzene, and (*d*) *cyclo*propane and 2-methylnaphthalene. In

the first three reactions the catalyst was aluminium chloride and in the fourth zirconium chloride.

In the reaction between *cyclo*propane and benzene with aluminium chloride as catalyst at a temperature of 25–30° C., the following products were identified: *n*-propylbenzene, dipropylbenzenes, tri- and higher propylbenzenes, and hexa-*n*-propylbenzene. The reaction between methyl*cyclo*butane and benzene in the presence of aluminium chloride at 25° C. produced, *iso*amylbenzene, and higher alkylated benzenes. *cyclo*Pentane and benzene in presence of aluminium chloride at 150° C. reacted to produce, amylbenzenes or isomers which were not individually characterized, *cyclo*pentylbenzene and probably dialkyl and higher alkyl benzenes. *cyclo*Propane and 2-methylnaphthalene in presence of zirconium chloride at 30–35° C. reacted to produce mono- and higher-propylated derivatives of naphthalene. H. E. T.

827. Liquid-Vapour Phase Equilibrium in the Ethane *n*-Heptane System. W. B. Kay. *Industr. Engng. Chem.*, 1938, **30**, 4, 459.—The border curves for 8 mixtures of ethane-heptane, together with those of the pure components, were determined over the complete range above 32° F. The relations between mol per cent., critical temperature and pressure, pressure at point of maximum pressure and at point of maximum temperature, and temperature at point of maximum pressure and at point of maximum temperature are all shown graphically. Densities were also determined.

The results were used to draw the temperature–composition diagram at constant pressure for the system, and the equilibrium constants obtained from this for ethane and heptane were compared with those given by Sherwood (Absorption and Extraction, McGraw Hill Book Co., 1937). The agreement was reasonably good for heptane over the entire range, but was only reasonably accurate for ethane up to about 200° F. Above that temperature the error was very large indeed. P. D.

828. Quantitative Analysis, with Respect to the Component Structural Groups, of the Infra-red (1–2 μ) Molal Absorptive Indices of 55 Hydrocarbons. F. W. Rose, Jr. *Bur. Stand. J. Res.* (*Wash.*), 1938, **20**, 129–157.—A number of effective methods for classifying unknown hydrocarbons and their mixtures have been developed in recent years, but known properties which yield information on the actual structural units of their molecules are rare.

It has been known for some years that infra-red absorption in the region 1·2–1·8 μ (5400–8900 cm.$^{-1}$) is different in both wave length and intensity for $-CH_3$, $>CH_2$, $\rangle CH$ and $>CH$ (aromatic) groups, and this has been used to obtain quantitative information concerning the structural units of hydrocarbon molecules.

This report gives results of a quantitative mathematical analysis of the infra-red-absorption curves of 54 hydrocarbons which have already been published.

It is shown that the total molal absorptive index K at any wave length, within the limits necessary to define the number of groups, follows the formula

$$(a)\ K = n_a a + n_b \beta \text{ for } N \text{ paraffins.}$$
$$(b)\ K = n_a a' + n_b \beta + n_c \gamma + n_d \delta \text{ for other hydrocarbons,}$$

where n_a, n_b, n_c and n_d are the number of $-CH_3$, $>CH_2$, $\rangle CH$ and $>CH$ (aromatic) groups and a (or a') β, γ and δ are the values respectively of the absorptive index for the respective unit group.

Equation (*b*) is shown to hold for branched-chain paraffins, *cyclo*paraffins (naphthenes) and aromatics including 10 of high molecular weight (C_{24}–C_{32}).

The N paraffins show in general excellent agreement with the calculated results, but the data for the *iso*paraffins does not show the same measure of agreement. In the case of the naphthenes and aromatics a critical source of error lies in the inadequate number of compounds available for study. With the hydrocarbons of high molecular weight, agreement between experimental and calculated coefficients is excellent, the average percentage deviations being generally $\pm 8\%$, which is roughly experimental error.

This method has been used to determine the number and types of structural groups in an unknown " *iso*nonane " recently isolated from a mid-continent petroleum.

D. L. S.

829. Interfacial Tensions of Some Mercury Hydrocarbon Oil Systems. II. J. L. Culbertson and K. D. Luedtke. *J. Phys. Chem.*, 1938, **42**, 4, 469.—In a previous paper the interfacial tensions of three oils against mercury were reported. These were obtained by the drop-weight method, and it was found that the time of drop formation could not be prolonged beyond three minutes, due to oil creeping. It was thought unlikely that the values obtained were equilibrium values. In the present paper the same oils were tested using the capillary tube method, and the results were compared with the drop-weight method. At 25° C. the new results are 1% lower than the old, and although small, the authors believe this to be a real effect. At higher temperatures (up to 90° C.) the difference between the new and old results is greater (up to 6%), which represents the lack of attainment of equilibrium in the previous work.

The authors conclude that equilibrium is reached in this system within less than 15 minutes. In addition to the 3 oils previously tested, a highly refined oil was tested, together with solutions in this oil of simple brominated hydrocarbons.

P. D.

830. Film Continuity of Synthetic Resin Coatings. G. H. Young, G. W. Gerhardt, W. K. Schneider and G. W. Seagen. *Industr. Engng. Chem.*, 1938, **30** (6), 685.—A study is made of the minimum coating of thermoplastic vinyl resins required to give a continuous film. The coating was applied to tin plates by the process of dipping and the degree of continuity of the film judged by the electrical resistance across the plate. It is concluded that the coating weight required to just produce film continuity varies directly with the vinyl acetate content and inversely with the average molecular weight. This observation is in agreement with a tentative theory involving partial orientation conditioned by the activity of the metal being coated and the effective polarity of the thermoplastic resin.

J. W. H.

Analysis and Testing.

831. Determination of Carbon Residue. K. Schröder. *Tekn. Tidskr.*, 14.5.38 (Kemi No. 5), 36–38.—The original Conradson method and a method recently developed in Czechoslovakia are briefly discussed. The laboratories of the Royal Swedish Navy have developed a method following the Conradson procedure, but employing an electrically heated oven. This oven is heated to 530/570° C. when the crucible is introduced. The oven is left without supervision for 50 minutes, when the crucible is removed and weighed as in the Conradson method. The careful supervision as prescribed in the original Conradson procedure is thus unnecessary, and several determinations may conveniently be run simultaneously by the same operator, or one oven may be used continuously throughout the day. Results are in good agreement with the original Conradson method :

	Oil " A."	Oil " Ub."	Oil " C."
Conradson method, average of 5 tests .	0·20	1·11	2·9
Revised method, average of 5, 7 and 4 tests	0·22	1·12	2·8

Work has been done to determine the temperature obtained with the original method, and the effect of varying the temperature of the electric oven. The latter appears to be unimportant.

R. F. S.

832. Apparatus for Determining the Dew Point of Gases Under Pressure. W. M. Deaton and E. M. Frost. *Bureau of Mines.* R.I. 3399, May 1938.—A description is given of an apparatus designed by the Bureau of Mines for determining the dew point

of gases under pressure, in connection with an investigation of gas hydrates and their relation to pipe-line operation. The apparatus consists of a stainless steel chamber with pressure gauge and thermometer which will withstand a pressure of 5500 lb. per sq. in. and into which the gas is admitted and deflected against a stainless steel mirror which can be viewed through a thermoplastic organic resin window. The mirror, on which the dew condenses, is soldered to a thermometer well fitting, which is in turn soldered to the inner end of a copper cooling tube, to which propane and butane can be supplied. Results are repeatable to within 0·2° F. and tests may be carried out to 3° below zero. C. L. G.

833. Qualitative Examination of Asphalts and Pitches. F. Neuber. *Petrol Z.*, 27.4.38, **34** (17), 1.—The following test is claimed to give characteristic results with materials from different sources.

0·5 gm. sample is dissolved in 10 c.c. CCl_4 and 1 drop of the solution evaporated on filter paper. The deposit is cut out and placed on another paper, where it is treated with 1 drop *iso*propyl alcohol; the soluble portion is absorbed on the lower filter paper; after further washings with separate drops of the solvent, the lower paper is dried, the residue so obtained having a characteristic appearance (daylight and ultra-violet light) for different types of sample.

The residue on the first filter paper is treated similarly with acetone, petroleum ether (b. pt. below 50° C.) and finally CCl_4. The appearances of the successive extracts are described. P. G. H.

834. Patents on Analysis. Kodak Ltd. E.P. 482,881–2, E.P. 482,884, 6.4.38. Improved vacuum distillation processes.

C. F. Goodeve. E.P. 482,950, 6.4.38. Apparatus for the measurement of viscosity and thixotropy. W. S. E. C.

Motor Fuels.

835. Study of the Chemical Composition of Surakhan Gasoline. P. S. Panutin and E. N. Firsanova. *Nat. Petrol. News*, 6.4.38, **30** (14), R. 160.—The gasoline was first fractionated into 4–5° C. fractions using a fractionating column of special design. A quantitative determination of 5- and 6-membered naphthenes was made by the method of dehydrogenation catalysis. The major constituents were found to be methyl*cyclo*hexane, *cyclo*hexane, and dimethyl*cyclo*hexane. The dehydrogenated products contained both *p*- and *m*-xylene which were isolated in the pure state. *o*-Xylene was not detected. The method for the removal of tertiary hydrocarbons by treatment with $SbCl_5$ was found to be unsatisfactory for quantitative examination. The method sufficed to establish the presence of *N*-heptane and 2 : 2-dimethylpentane but *N*-octane was not detected. H. G.

836. Volatility of Motor Spirits in Relation to Detonation. O. Herstad. *Oel u. Kohle*, 1937, 13, 1007.—According to conditions (temp. etc.) in induction system, fuel enters combustion space partly as vapour and partly as liquid droplets. The rate of vaporization of the latter, in contact with hot walls of cylinder, is a factor influencing performance. The composition of the entering droplets depends on the extent of pre-gasification. This relationship was studied by tests on fractions obtained from a standard benzine by two methods:—

(1) A series of distillates and residues was obtained by evaporation at a succession of successively constant temperatures (60–150° C.).
(2) 10° cuts obtained by an ordinary distillation.

Each fraction was then volatilized under standard conditions on a metal plate at a succession of increasing temperatures (100–800° C.). (See Abstract No. 218, 1937.) A transformation curve could be drawn for each fraction, plotting rate of evaporation against temperature. In every case, the time of evap. decreased with rising temp., reached a minimum and then increased very rapidly to a maximum.

The curves for the residues (1) all lay above that for the original benzine, indicating that the higher the degree of pre-gasification the higher must be the wall temperature in order to vaporize the liquid part of the entering fuel.

The volatilization time maxima of the residues, however, fall on the transformation curve of the original benzine at corresponding temperatures. This is taken to indicate the close chemical relationship between the fractions. Therefore, so far as evaporation time is concerned, the detonation properties of the fractional residues should be comparable with those of the original sample.

10° cuts (2) gave curves generally similar to those for (1). The speed of gasification at the minimum point increased as mean b. pt. of the cut rose, and was inversely as the boiling range. The benzine itself therefore gasifies more slowly than any of its fractions. P. G. H.

837. Tetra Ethyl Lead Responsiveness of Two Hydrocarbons. H. M. Trimble and J. O. Richardson. *Oil Gas. J.*, 31.3.38, **36** (46), 130.—A method of comparing various gasolines in regard to their relative lead response has been devised. It is not satisfactory to compare the increase in octane rating resulting from addition of a given amount of T.E.L. unless the unleaded fuels have the same octane number. It is proposed, therefore, to compare the responses of given fuels with those of *iso*-octane–*n*-heptane blends of similar original octane numbers. Examples of the T.E.L. responsiveness of several types of fuels up to concentration of 3 mls./gal. are given and compared with the corresponding *iso*-octane–*n*-heptane blends. *Iso*pentane is shown to be more responsive than *iso*-octane–*n*-heptane blends and natural gasoline, straight-run and cracked less responsive. A method of extending the range to cover points above 100 octane number has also been devised. For this purpose blends of benzene and *iso*-octane containing more than 75% benzene in *iso*-octane have been used as a basis. Below this benzene concentration there is little difference in anti-knock value between the benzene blend and *iso*-octane itself. Blends containing 94 to 100% of *iso*-octane in *n*-heptane were matched against benzene in *n*-heptane and on extrapolation a value of 117·6 obtained as the octane number of benzene. Octane numbers could thus be assigned to T.E.L. blends above 100 octane number, and the curves determined were reasonably in line with the trend indicated by those of other blends. The primary reference fuels and various blends of them were then tested, rating in the usual manner for octane numbers of 100 or less, but against benzene/heptane blends for values over 100. In this way *iso*-octane plus 6 mls. T.E.L./gal. has an octane rating of 118·7. Tables show the octane numbers assigned to various blends of *iso*-octane and *n*-heptane with addition of T.E.L. in increments of 1 ml./gal. up to a concentration of 6 mls./gal. During compilation of this data a curve relating octane number with compression ratio for constant knock intensity was drawn and has proved to be of great value as a guide to indicate correct compression ratios in routine testing. Two methods for determining the lead susceptibility of a test fuel, expressed as a ratio of the susceptibility of a primary reference fuel of the same original octane number, are described. R. A. E.

838. Official Swedish Specifications for Motor Fuels. Anon. *Tekn. Tidskr.*, 21.5.38, (Automobil och Motorteknik No. 5), 37–38.—The specifications previously suggested (cf. Abstract 1256, 1937) have been revised and adopted on 9th November 1937.

With respect to the grade BrO–I the lower pour point shall correspond with the lower aniline point, and vice versa. Consumers are advised to consult the engine manufacturers as to whether high aniline point or low pour point is to be preferred. BrO–I is intended for automotive and similar engines operating at 1000 r.p.m. and higher, BrO–II for engines operating at less than 1000 r.p.m. BrO–III for engines equipped with fuel pre-heaters and BrO–IV for engines equipped with fuel pre-heaters and chilled nozzles operating at less than 450 r.p.m.

Volatile Fuels.

Type.	Gasoline.	Lättbentyl.	Aviation Gasoline 70.	Aviation Gasoline 73.	Aviation Gasoline 80.	Aviation Gasoline 87.	Kerosine for Ignition Engines.	Kerosine for other than Ignition Engines.
Designation	Be	Lbt	F–Be–70	F–Be–73	F–Be–80	F–Be–87	Mofg	Mof
General appearance	note 1	note 1	note 1	note 1	note 1	note 1	note 1	—
Specific gravity	note 2	note 2	note 2	note 2	note 2	note 2	note 2	note 2
Corrosion A.S.T.M. D130–30	pass	note 3	pass	pass	pass	pass	pass	—
Distillation A.S.T.M. D86–35 :								
I.B.P., *max.*	50° C.	50° C.	—	—	—	—	170° C.	—
% over at 50° C., *max.*	10%	10%	—	—	—	—	—	—
% over at 70° C., *min.*	—	10%	10%	10%	10%	10%	—	—
% over at 75° C., *min.*	10%	—	—	—	—	—	—	—
% over at 100° C., *min.*	—	50%	50%	50%	50%	50%	—	—
% over at 125° C., *min.*	50%	—	—	—	—	—	—	—
% over at 150° C., *min.*	—	—	90%	90%	90%	90%	—	—
% over at 210° C., *min.*	—	—	—	—	—	—	50%	—
% over at 290° C., *min.*	—	—	—	—	—	—	—	95%
F.B.P. *max.*	205° C.	205° C.	180° C.	180° C.	180° C.	180° C.	290° C.	—
Distillate at F.B.P., *min.*	96%	96%	96%	96%	96%	96%	96%	—
Flash point (Abel), *min.*	—	—	—	—	—	—	21° C.	21° C.
Vapour pressure A.S.T.M. D417–35T, kilo/sq. cm., *max.*	0·8	—	0·5	0·5	0·5	0·5	—	—
Octane No. C.F.R. M.M., *min.*	65	75	70	73	80	87	35	—
Tetraethyl lead content, volume %, *max.*	0·08%	none	none	none	0·06%	0·09%	—	—
Other requirements	none	note 4	none	none	none	none	none	none

Note 1. Shall be clear, well refined, free from water and mechanical impurities, neutral towards litmus.
Note 2. Specific gravity shall be determined, but no limits imposed.
Note 3. In the case of Lättbentyl, a zinc strip shall be added. This, and the copper strip, may show only extremely slight discoloration.
Note 4. Lättbentyl shall consist of 75 wt.% gasoline and 25 wt.% ethyl alcohol. A tolerance of ±3 wt.% is allowed. The ethyl alcohol shall be at least 99% concentrated and denatured with croton aldehyde. The Lättbentyl must not become turbid, or the alcohol separate, when 300 c.c. are shaken with 2 c.c. water at 20° C., or when chilled to −40° C.

Diesel Fuels.

Designation.	BrO–I.	BrO–II.	BrO–III.	BrO–IV.
Viscosity, in Vogel's or other apparatus for determination of kinematic viscosity :				
at 20° C., *max.*	9	35	70	—
at 50° C., *max.*	—	—	—	100
Pour point, A.S.T.M. D97–34, *max.*	−25 and −5° C.	±0° C.	±0° C.	*
Hard asphalt DIN, DVM 3660, *max.*	0·1%	1·0%	1·2%	12%
Ash, I.P.T., GO–10, *max.*	0·01%	0·03%	0·05%	0·10%
Water, A.S.T.M. D95–30, *max.*	0·10%	1·0%	1·0%	1·0%
Mechanical impurities, I.P.T. FO–14a, *max.*	trace	0·1%	0·5%	0·5%
Sulphur, A.S.T.M. D129–34, *max.*	1·5%	2·0%	2·5%	—
Distillation, A.S.T.M. D158–28, % at 350° C., *min.*	85%	—	—	—
Net calorific value, A.S.T.M. D240–27, kg. cal./kg., *min.*	10·000	9·800	9·700	9·500
Aniline point, I.P.T. FO–23, *min.*	45° C. and 60° C.	—	—	—

* Sufficiently low to permit handling of oil.

R. F. S.

839. Patents on Motor Spirit. Process Management Co. and A. H. Stevens. E.P. 482,978, 8.4.38. Production of gasoline by polymerizing cracking gases which are substantially free from H_2 and CH_4, at 1200° F. and under a pressure of 500 lb./sq. in.

V. Ipatieff and H. Pines. U.S.P. 2,112,846, 5.4.38. Production of motor spirit from cracked gas mixtures containing *iso*butane and *iso*butylene by adding aluminium chloride and passing hydrogen chloride into the mixture at 0° C. or <0° C. to alkylate *iso*butane with *iso*butylene.

R. C. Osterstrom. U.S.P. Re. 20,703, 19.4.38 (cf. U.S.P. 1,897,328, 14.2.33). Decolorizing and degumming gasoline distillates by treating them with solid adsorbent catalysts, *e.g.* fuller's earth, at 200 lb. pressure/sq. in., and above 500° F. The pressure is reduced to separate the vapours and the latter are treated with fresh adsorbent.

C. H. Greenewalt. U.S.P. 2,113,588, 12.4.38. Method of separation of gasoline from gases.

W. A. Patrick, Jr. U.S.P. 2,114,313–5, 19.4.38. Removal of sulphur and gum-forming constituents from motor spirit by treatment in the liquid phase with up to 1% of sulphur chloride in the presence of a catalyst, *e.g.* fuller's earth, Cu, Pb, Zn, finely divided anhydrous sulphides of Cu, Pb, Sn, As, Sb, at elevated temperatures.

D. S. McKittrick. U.S.P. 2,114,852, 19.4.38. Desulphurizing cracked distillates by distilling them with a preferential solvent for thiophenes, *e.g.* furfural, methyl cyanide or ethylene diamine.

H. Egli. U.S.P. 2,114,524, 19.4.38. Production of gasoline of high aromatic content from mixtures containing gasoline and higher-boiling components by extraction in two stages with a selective solvent.

H. Broche and H. Schmitz. U.S.P. 2,115,549, 26.4.38. Desulphurizing motor spirit by treatment with diluted H_2SO_4 (60° Baumé) at normal temperatures and then heating the mixture in a closed vessel in the presence of alkaline hydroxide or alkali-earth hydroxides at 90–150° C. and under pressure as developing in the vessel.

W. S. E. C.

See also Abstract No. 825.

Gas, Diesel and Fuel Oils.

840. Behaviour of Diesel Fuel at Low Temperatures. L. Rosenfeld. *Petrol. Times*, 7.5.38, 593; 14.5.38, 627.—The effect on C.C.R. of changes in air temperature when operating on each of six different fuels was investigated in a standard C.F.R. single-cylinder testing engine equipped with a direct ignition head. The suction air was cooled to minus 22° F., and cylinder temperatures were maintained at different levels by the use of various cooling fluids such as methyl alcohol (149° F.) and sulphuric ether (35° C.). The fuels were of low pour point prepared from Bibi-Eybat, Emba, Balachany and Ocha crudes and displayed a range of cetene values from 44·5 to 65·5. The results showed that the C.C.R. falls with rise of temperature and that the influence of change in the temperature of suction air and of cooling medium is practically the same. The specific reaction of the different oils was different, however. It follows that the cetene value gives no information concerning the ignition quality of a fuel at changed temperature conditions. Tests carried out with oils containing amyl-nitrite indicated that such additions cannot be recommended on economic grounds. In investigating the filterability of the oils at low temperature a standard Bosch injection equipment for a 4-cylinder engine with an original Bosch cloth filter was connected to a cooling device capable of cooling the oil to minus 70° F. Manometers were fixed on both sides of the filter. Three grades of each of three oils of Bibi-Eybat origin were used. The three grades comprised (*a*) normal oil with regard to impurities present; (*b*) oil filtered once at room temperature, and (*c*) oil freed from asphaltic matter by acid treatment. The results showed that impurities alone caused pumping difficulties. Asphaltic matter and high viscosity due to low temperature did not cause choking of the filter. H. G.

841. Patents on Fuel Oil. F. Uhde and T. W. Pfirrmann. E.P. 482,783, 5.4.38. Preparation of synthetic diesel oil by blending an oil poor in hydrogen obtained by hydrogenation of brown coal etc., with an oil rich in hydrogen prepared from CO and H_2 or by hydrogenation of coal. W. S. E. C.

Lubricants and Lubrication.

842. Reclassification of Gear Lubricants. Anon. *Lubr. Maint. & Petrol. Marktr.*, 1938, **6** (4), 7.—The new classifications for gear lubricants as they will appear in this year's edition of the S.A.E. Handbook, are given.

S.A.E. 80 is evaluated on the basis of its viscosity at 0° F., S.A.E. 90 remains the same, S.A.E. 140 is a new classification and this as well as the S.A.E. 250 classification, is based on viscosity at 210° F. The limits are shown below :—

S.A.E. Viscosity Number.	Viscosity Range, Saybolt Universal.	Must not Channel in Service at ° F.
S.A.E.–80	100,000 seconds at 0° F. max.	−20
S.A.E.–90	800 to 1500 seconds at 100° F.	0
S.A.E.–140	120 to 200 seconds at 210° F.	+35
S.A.E.–250	200 seconds at 210° F. min.	—

W. E. J. B.

843. Effect of Nitric Acid on the Ageing of Lubricating Oils in I.C. Engines. C. Ehlers. *Petrol Z.*, 11.5.38, **34** (19), *Motorenbetrieb*, p. 2.—It is known that residues, C, and sludge from used oils often contain HNO_3, formed from N of air during combustion. Presence of moisture and high compression are known to encourage formation of HNO_3, but the exact conditions most favourable to this reaction have not been established. Previous work has shown that HNO_3 tends to concentrate in oil "residues" and not in the oil itself. Present work attempts to decide whether the acid attacks metal parts, giving salts which increase friction for which oil is blamed, or whether its action on the oil is direct.

Comparative oxidation tests on commercial motor oils of different quality were made with O_2 and $O_2 + N_2O_3$, respectively, both with and without the presence of copper.

Effect of including N_2O_3 in oxygen stream was to darken the oil and to give an actual precipitate, insoluble in normal benzine. The usual tests applied to the aged oils showed that the oils themselves were vigorously attacked and that the source and original quality of the oils were of little significance if N_2O_3 was present. The chief effect of the latter was to increase carbon residue and sludge formation. If a residue or sludge from a used oil contains HNO_3, the cause of the condition of the oil must not necessarily be attributed to the quality of the oil itself. P. G. H.

844. Contribution to Viscosimetry. A. Bondi. *Petrol. Z.*, 9.2.38, **34** (6), 1.—The microviscometer described by Levin (*Ind. Eng. Chem. (Anal.)* **9**, 1937, p. 147) was used in a study of (*a*) viscosity–temp. coefficient of lub. oils and asphaltic bitumens; (*b*) viscosity of blended oils in relation to components. Viscosity pole-height (V_p), regarded as best measure of temperature susceptibility, was studied. The assumption that V_p is the same for all oils of one origin was found to be unsound; for a given crude the V_p of fractions was found to increase as width of cut decreased.

V_p is no guide to the distribution of hydrocarbons in an oil, viscosity being dependent on the stereometric structure of the molecules and not on their chemical composition. No relation exists between V_p and volatility.

In author's opinion, lubricity (gauged by friction losses) of an oil in a bearing is mechanical and can be expressed without reference to surface phenomena. Pressure coefficient is of more significance than temperature susceptibility; the former is sensitive to small additions of "dope," whereas the latter cannot be so affected. This treatment of lubricity can thus explain known effect of adding fatty acids to a lub. oil.

The viscosities of a large number of bitumens, plotted on the Walther temperature diagram, gave straight lines, but in the case of coal-tar pitches the incidence of the K–S and Ubbelohde melting points on transverse lines corresponding to a fixed viscosity could not be confirmed.

The additivity of V_p in blends was only imperfectly valid. Nevertheless for V_p range 1·8–4·0 V_p was sufficiently additive for practical purposes if hydrocarbon oils only were concerned. P. G. H.

845. Official Swedish Specifications for Ignition Engine, Transmission, and Gear Box Lubricants. E. Norlin. *Tekn. Tidskr.*, 21.5.38, (Automobil och Motorteknik No. 5), 33–37.—A brief discussion of the available types of engine lubricants, their com-

position, manufacture, and general characteristics, together with a description of methods of test and suggested schemes for purchase and control. The Swedish Association of Engineers and Architects have issued specifications covering both paraffinic and mixed base oils, designated Pb–M–20 etc., and Bb–M–20 etc., where the letters Pb and Bb refer to the base of the oil, paraffinic or mixed, and the numerals following the letter "M," indicating motor oil, refer to the approximate viscosity in centistokes at 50° C., as follows :—

Paraffinic Base Oils.

Designation	Pb–M–20	Pb–M–40	Pb–M–65	Pb–M–90	Pb–M–115	Pb–M–150
Viscosity, 50° C.	15–30	35–45	50–70	75–95	100–125	135–165
Polar height, *max.*	2·10	2·10	2·10	2·10	2·10	2·10
Specific gravity +20° C., *max.*	0·875	0·880	0·885	0·890	0·890	0·895
Flash point, P.M., *min.*	190° C.	190° C.	200° C.	210° C.	220° C.	230° C.
Pour point, *max.*	−15° C.	−15° C.	−10° C.	−5° C.	0° C.	0° C.
Conradson carbon residue, *max.*	0·3%	0·5%	0·8%	1·0%	1·3%	1·5%
Sligh No., *max.*	10	10	8	3	3	3

Mixed Base Oils.

Designation	Bb–M–20	Bb–M–40	Bb–M–65	Bb–M–90	Bb–M–115	Bb–M–150
Viscosity, 50° C.	15–30	35–45	50–70	75–95	100–125	135–165
Polar height, *max.*	2·30	2·30	2·30	2·30	2·30	2·30
Specific gravity, +20° C., *max.*	0·900	0·900	0·905	0·905	0·910	0·910
Flash point, P.M., *min.*	170° C.	180° C.	190° C.	200° C.	210° C.	220° C.
Pour point, *max.*	−25° C.	−20° C.	−15° C.	−10° C.	−5° C.	−5° C.
Conradson carbon residue, *max.*	0·2%	0·3%	0·5%	0·7%	0·8%	1·0%
Sligh No., *max.*	10	10	8	5	3	3

In both cases it is stipulated that the lubricants shall be pure mineral oils, although addition of inhibitors and pour-point depressors is permitted. The Polar Heights specified correspond to V.I. 87 and 75, respectively. Two grades of transmission and gear box lubricants are specified, for use in ordinary transmission and gear boxes, but not for lubrication of hypoid gears :

Designation	V–150	V–350
Viscosity, 50° C.	70–250	250–450
Specific gravity, +20° C., *max.*	0·940	0·950
Flash point, P.M., *min.*	180° C.	200° C.
Pour point, *max.*	−10° C.	+5° C.
Hard asphalt, *max.*	0·05%	0·10%

R. F. S.

846. Patents on Lubricating Oil. G. Bottaro. E.P. 482,434, 25.3.38. Improved counter-current apparatus for liquid/liquid or solid/liquid systems.

S. Bramley-Moore. E.P. 482,462, 30.3.38. Apparatus for testing the efficiency of lubricating oils.

N.V. de Bataafsche Petroleum Mij. E.P. 482,549, 31.3.38. Process for re-activation of clay.

C. C. Wakefield and Co. Ltd., and E. A. Evans. E.P. 483,306, 14.4.38. Lubricating oils, *e.g.* turbine oils, which develop acidity after use, are stabilized by adding 0·05–1·0% by wt. of tertiary butyl cresol.

A. P. Lowes, D. E. White and I.C.I. Ltd. E.P. 483,316, 19.4.38. Preparation of synthetic lubricating oils by condensation of chlorinated paraffin wax with benzene or its homologues in the absence of a condensation agent. The mixture is then cooled, the solids separated, and the residual liquids subjected to condensation in the presence of aluminium chloride if desired after the addition of more aromatics.

Standard Oil Development Co. E.P. 483,453, 20.4.38. Production of polymers of high mol. wt., to thicken lubricating oils, by forcing liquid *iso*butylene into a bath maintained at −10° C., containing a liquid normally gaseous compound boiling at a lower temperature than *iso*butylene—and boron fluoride.

Standard Oil Development Co. E.P. 483,796, 26.4.38. Dewaxing hydrocarbon oil using methyl or ethyl normal butyl ketone.

Texaco Development Co. and E. C. Knowles. E.P. 483,818, 21.4.38. Dewaxing of hydrocarbon oil in the presence of a naturally occurring or an added wax crystal modifying substance and dissolving the oil at 52° C. in an aliphatic ketone as solvent.

C. F. Tears. U.S.P. 2,113,008, 5.4.38. Propane dewaxing and partial decolorizing of hydrocarbon oils.

B. H. Lincoln. U.S.P. 2,113,809, 12.4.38. Centrifugal dewaxing apparatus.

G. X. Henshaw. U.S.P. 2,113,841, 12.4.38. Apparatus for re-refining used lubricating oil.

A. A. Neff. U.S.P. 2,114,352, 19.4.38. Method of neutralizing high-boiling petroleum oils.

S. C. Fulton and J. M. Whiteley. U.S.P. 2,114,467, 19.4.38. Dewaxing hydrocarbon oils by adding a polymer produced by treating the vacuum distillate of cracking hydrocarbon oils with metallic halides. The catalytic sludge is separated, the mixture chilled and the wax removed.

G. A. Beiswenger. U.S.P. 2,115,003, 26.4.38. Recovery of liquefied propane in propane dewaxing, by heating the propane/oil mixture to 180–204° F. and separating the two layers.

W. V. Overbaugh. U.S.P. 2,115,211, 26.4.38. Continuous filtration of waxy oil using a rotary vacuum filtering surface.

W. S. E. C.

Asphalt and Bitumen.

847. Weathering Tests on Filled Coating Asphalts. O. G. Strieter. *Bur. Stand. J. Res.* (*Wash.*), 1938, **20**, 159–171.—Two asphalts of different softening points, made from the same crude in a single operation but differing in the duration of blowing, were used for preparing the asphalt-filler mixtures.

These asphalts were so blended that when combined with 15, 25 and 35% wt. of various mineral fillers the softening points of the resulting mixtures were approximately the same as that of the original harder asphalt. 57 different combinations of asphalt and asphalt-filler mixtures were prepared for this work.

The particle size, specific gravity, compacting weight and fineness factor of all the fillers were determined.

The panels prepared from these mixtures were exposed to outdoor weathering in several localities and to accelerated weathering tests.

Results showed that similar results were obtained both by outdoor and accelerated tests and the following conclusions were reached :—

1. The addition of fillers increased the durability of coating asphalt to a degree depending on character, proportion and particle size of the fillers.
2. Hydrated lime was the only filler tested which did not increase the durability of the coating and when present to the extent of 35% destroyed the adhesive properties of the coating.
3. The higher the percentage of a given filler, the more durable was the coating.
4. The question of the most suitable particle size and distribution of the filler was not settled. However, fillers passing a No. 100 sieve but retained on a No. 200 produced better coatings than fillers all of which passed a No. 200 sieve.

The paper is profusely illustrated with photographs. D. L. S.

848. Applications of Surface Chemistry and Physics to Bituminous Mixtures. N. W. McLeod. *Proc. Ass. Asph. Pav. Technol.*, 1937, **9**, 1–57.—The paper gives an account of investigations into the possibility of changing the surface characteristics of aggregates and soils, to permit coating of wet aggregates with bituminous binders and confer water-repelling properties on soils for soil stabilization. It is pointed out that a similar change of surface characteristics is effected with minerals in flotation processes by the use of wetting and activating agents. In the wet aggregate coating experiments,

30 gm. of aggregate of 8- to 40-mesh grading were mixed with distilled water and excess drained off, 1 gm. of bituminous oil and the reagents then added and mixed, the reagents being added separately in small amounts until further addition had no effect on the coating. The mixture was next compared with a standard obtained with the smallest amounts of lead or copper salts and soap required to completely coat the wet aggregate. The experiments showed that water could be displaced by bitumen from the aggregates examined, and that activating agents were required in addition to wetting agents with all siliceous, but not with all limestone, aggregates. Salts of lead, copper, aluminium and iron appeared to be the most effective activating agents and were equally effective whether added in water, bitumen, emulsions or any combination. The amount of reagents required was not affected by amount of water on the aggregate, and smaller amounts were required with increasing bitumen content; for bitumen from a given source the amounts generally decrease with increasing viscosity, asphaltene and carbene contents. The cost of reagents for treating wet aggregate is not much greater than for drying, and it is thought that treatment would be very valuable for wet locations and for aggregates easily stripped by water. In connection with soil stabilization, it is shown that water-repelling properties can be conferred on soils by altering the contact angle by the use of the same reagents, and in the experiments the magnitude of the contact angle was estimated, by the sedimentation volume method, for silica and limestone dust and natural silt before and after treatment with reagents.

The treatment consisted in mixing 100 gm. of powder with the activating agent, and distilled water to give 100 c.c. of solution; this was allowed to stand for one day with occasional stirring, when the wetting agent was added, and the mixture again allowed to stand with stirring and then dried in an oven. Before determining sedimentation volumes the treated powders were extracted alternately with water and carbon tetrachloride five times, drying after each extraction. It was not possible to develop contact angles greater than about 25° with water solutions of the reagents but a marked hysteresis effect with regard to capillary rise was noted with an angle of approximately 25°. The author is of the opinion that it is necessary to use bituminous materials or oils in soil stabilization in order to obtain a sufficiently high contact angle to reduce the amounts of reagents required and to supply the cohesive properties normally given by water. The use of soap alone is of little value, but with certain activating agents greatly increases adhesion.

It is suggested that the compounds formed by the reagents at the surfaces of siliceous aggregates must be attached by primary valencies, and for this reason most polyvalent metallic cations function as activating agents, whereas divalent and monovalent cations are not effective. With limestone the reaction compounds are adsorbed chiefly by secondary valencies. A. O.

849. Testing Adhesion Between Bitumen and Mineral Surfaces with Alkaline Solutions. H. F. Winterkorn, G. W. Eckert, and E. B. Shipley. *Proc. Ass. Asph. Pav. Technol.*, 1937, **9**, 63–85.—The authors discuss the results of an investigation of the Riedel and Weber test for adhesion of bituminous materials to aggregates. Tests were made with sand and gravel with a cutback and two road oils, and in order to avoid effects of freshly broken surfaces the gravel was not powdered, the coated sand was formed into briquettes and tested after curing under various conditions. Tests were also made by a wash method which consisted of rotating flasks, containing the specimen with distilled water, in a water bath and inspecting the specimen for stripping of the coating after one hour at 30° C., 45° C., 60° C. and 70° C. Tests in which the gravel was given a priming coat with aniline–furfural, phenol–furfural and Rosin B before coating with binder indicated that these materials had a beneficial effect on adhesion, and tests were therefore made with cutbacks containing various amounts of different resinous materials. It was concluded from the investigations that, contrary to the views of Riedel and Weber, certain bitumens may adhere to hydrophilic materials; the use of alkaline solutions is not satisfactory; the Riedel and Weber test with boiling distilled water and the wash test appear to give comparable results. Precoating siliceous gravel with certain resinous materials increases the resistance to stripping of bitumen by water, but addition of these materials to bitumen is not always effective and depends on the character of the bitumen and resin. Very fluid or very brittle bituminous films appear to be more easily removed than plastic films. It is pointed out that the curing

and immersion conditions affect the results, and test conditions should be adjusted to simulate the conditions encountered in practice, and solutions found on the construction site should be used instead of distilled water if a test is to be of value in determining the suitability of construction materials. A. O.

850. Adhesion of Asphaltic Binders to Mineral Aggregates. V. B. Saville and E. O. Axon. *Proc. Ass. Asph. Pav. Technol.*, 1937, **9**, 86–101.—Investigations made in connection with the use of chert gravel in a base course of an asphaltic pavement built in 1932 are discussed. Test sections were included in the pavement to study the effect of the use of different asphalts, use of gravel instead of flint in the surface course, use of limestone instead of gravel in the base course and use of surface mix mortar in the base instead of the normal base mix mortar. Field observations consisted of examination of cores from the pavement every six months; these indicated that all sections were good until the third year, after which many of the cores from the chert gravel section showed extensive stripping, while limestone or dense mortar sections appeared to be unchanged. In the fifth year the limestone cores were still in good condition but all gravel cores showed stripping. Laboratory investigations were undertaken to examine the effect of different asphalts and aggregates on adhesion and the possibility of changing the adhesion properties by surface treatment of aggregates. In the early work, modifications of the Nicholson and Riedel and Weber methods for examining adhesion were used, but later a third method was employed. This consisted of immersing the sample in distilled water for a given period and then rotating a flask containing 50 gm. of sample and 175 ml. of distilled water for one hour. It is concluded that chert gravel is hydrophilic; pavements constructed with coarse hydrophilic aggregates must be sufficiently dense to exclude water; treatment of chert gravel with certain materials offers a means of conferring hydrophobic properties; methods suitable for testing fine aggregates may not be suitable for coarse aggregates; the available information concerning adhesion does not enable the behaviour of aggregates in asphaltic mixtures to be predicted. A. O.

851. Binding Properties of Bituminous Binders. H. Mallison. *Asph. u. Teer*, 1938, **38** (16), 231–233.—It is pointed out that tests which depend on evaporation in thin films for examining viscosity increase of tars do not simulate practical conditions where traffic action prevents skin formation. Details of a method are given in which the binder acts as lubricant for a roller bearing and the temperature increase due to friction is observed over a period of 8 hours and the increase in drop point determined at intervals. Tests on a series of binders of 50 secs. Road Tar viscosity at 30° C. showed that a blend of mineral oil and bitumen gave a normal temperature increase and practically no thickening; normal road tars gave greater temperature increases and thickening in proportion to the middle oil content; with crude tar the temperature increase was in the road-tar range, but the drop point did not increase to the same extent and this is said to indicate unsuitability of the tar for road construction purposes. The method is not suitable for testing cold tars. A. O.

852. Bituminous Binding Materials. A. B. C. Dahlberg. *Tekn. Tidskr.*, 28.5.38, (Väg- och Vattenb. No. 5), 57–61.—The characterization of bitumen by means of penetration, softening point, viscosity, float test, drop point, etc., the results being expressed in a large number of units not corresponding with each other, does not afford the desired information regarding the properties of the material. The expression of consistency in absolute units is therefore recommended. At low temperatures consistency is usually determined by means of penetrometers, and at high temperatures by viscosimeters, but in both cases results should be expressed in absolute units.
R. F. S.

Special Products.

853. Carbon-Black Rubber Mixtures. C. R. Park and P. P. McClellan. *Industr. Engng. Chem.*, 1938, **30** (6), 704.—The effect of heat upon the properties and structure of carbon-black rubber mixtures has been studied, and progressive stiffening is shown to accompany heat treatment. This stiffening is shown, by means of microphotographs, to be due to an increase in the degree of flocculation which takes place on heating.

Carbon-black rubber mixtures containing free-flame process black do not increase in stiffness on heating to the same extent as channel process carbon-black rubber mixtures. J. W. H.

854. Patents on Special Products. Phillips Petroleum Co. and A. H. Stevens. E.P. 482,427, 24.3.38. Preparation of normal olefines containing 1- and 2-olefines from mixtures of olefines and paraffins containing secondary and tertiary olefines.

I.G. Farbenindustrie A.-G. and W. W. Groves. E.P. 482,507, 29.3.38. Manufacture of polymerization products by treating a polymeric compound containing carbonyl groups other than a polyvinyl ketone with an alkaline agent.

G. W. Johnson. E.P. 482,547, 28.3.38. Stabilizing poly*iso*butylene by adding up to 1% of a cyclic amine or phenol.

G. W. Johnson. E.P. 482,573, 28.3.38. Stabilizing poly*iso*butylene by adding up to 1% of an organic sulphide.

Universal Oil Products Co. E.P. 483,185 and E.P. 483,189, 13.4.38. Conversion of aliphatic into cyclic, particularly aromatic hydrocarbons, by subjecting them at 400–700° C. and under 0·25–7 atm. pressure to treatment with a solid granular catalyst containing a major proportion by weight of aluminium oxide and supporting a minor proportion by weight of an oxide of vanadium, columbium or tantalum.

N.V. de Bataafsche Petroleum Mij. E.P. 483,400, 20.4.38. Manufacture of organic addition compounds containing metals to add to natural or synthetic lubricating oils, brown coal products, tar oils and gasolines, *e.g.* silver naphthyltriethyl phosphine, nickel diphenyl trimethylphosphine.

Universal Oil Products Co. E.P. 483,417, 20.4.38. Conversion of aliphatic into cyclic hydrocarbons in particular, aromatic hydrocarbons by contacting them with solid granular catalysts containing a major proportion by weight of a refractory carrier of relatively catalytic activity, *e.g.* bauxite, Kieselguhr, magnesium or aluminium oxides, supporting a minor portion by weight of a substance of relatively high catalytic activity selected from compounds of titanium, zirconium, cerium, hapnium and thorium.

A. Lazar. U.S.P. 2,114,126, 12.4.38. Production of resin oil from petroleum oil by treating uncracked petroleum oil heavier than kerosene with SO_2, removing the solvent and distilling the oil in the presence of alkali and recovering the condensate of sp. gr. not below 0·965.

E. H. Crawley. U.S.P. 2,114,796, 19.4.38. Preparation of a petroleum resin in which latex rubber is 25% soluble, from the residue resulting from the solvent treatment of hydrocarbon oil which has not been previously cracked or chemically treated. W. S. E. C.

855. Patents on Wax. D. W. F. Hardie and I.C.I. Ltd. E.P. 482,658, 1.4.38. Chlorination of paraffin wax to give light coloured products by dispersing paraffin wax in water or a dilute aqueous alkali and treating the dispersion with gaseous chlorine at temperatures not above 30–40° C.

G. W. Johnson. E.P. 482,954, 7.4.38. Preparation of oxidation products from mixtures containing paraffin waxes. W. S. E. C.

See also Abstract No. 830.

Coal and Shale.

856. Spraying Coal with Oil. Anon. *Lubr. Maint. & Petrol. Marktr.*, 1938, **6** (4), 17–19.—This article reviews the history of the treatment of coal with various agents, *e.g.* water, calcium chloride solution and oils, with the object of rendering the coal dust-free.

The paper discusses properties of a suitable oil and states that oils are in use with viscosities ranging from 70 to 350 Saybolt secs. at 100° F.

An average cost for oil treating a ton of coal using three quarts of oil per ton is calculated at 7 cents per ton. W. E. J. B.

BOOK REVIEWS.

Lubricating Greases : Their Manufacture and Use. By E. N. Klemgard. Pp. 873. New York, Reinhold Publishing Corporation. Chapman and Hall, Ltd., London. 75*s.* 0*d.* net.

Like so many other industries founded upon empirical procedure, the manufacture of lubricating greases is rapidly yielding to modern methods of organized investigation and control. A decade or so ago it did not seem possible that greases would retain their position as lubricants of important machinery. It was fully anticipated that mechanical improvements in the supply of oil to bearings, especially the use of mechanical lubricators, would gradually eliminate the employment of these rather indeterminate solid and semi-solid mixtures. The reverse has proved to be the case. Greases of one kind or another are being used in ever-increasing quantities for lubricating purposes. They are better understood, their manufacture is being more rigorously controlled and their practical application has been made the subject of much organized observation.

These changes are mirrored in the vast difference between the new edition of Klemgard's work and the earlier book of 1927. The present volume of nearly 900 pages is over five times the size of the original. This is not only a measure of newly acquired knowledge and modern advances in manufacture : it is indicative of the demand for a different and more highly scientific outlook upon the whole subject.

The new " Klemgard " is virtually indispensable to all interested in the design and manufacture of greases. It will also prove of great value to those engaged in their use. It must not be supposed, of course, that the book can take the place of the laboriously-won knowledge of the experienced grease maker or that it is possible by its use to solve the frequent and intricate problems with which the chemist is confronted in grease works control. For one thing raw materials vary in composition even when of the highest obtainable standard. Small differences in p_H value, of fineness of sub-division, of unsaponifiable content, and a dozen other matters may seriously affect the consistency or appearance of the finished product. For another, the quite indescribable variations in the rates of heating or cooling, of the effect of water content at different stages of manufacture, of mechanical treatment and so on, are vital in their effect upon structure and upon the important properties of thixotropy and syneresis. General effects only can be described. They must necessarily be adapted to individual products, conditions of manufacture and availability of raw materials. Results, however, must automatically follow understanding of the basic principles described and use of the wealth of vicarious experience recorded and collated in this quite remarkable book.

Klemgard has left no stone unturned to render his treatise complete. There are some 1200 references to technical and patent literature. The specifications and experience of many countries have been combed to provide data for manufacturing formulas or used as commentaries upon methods described. It is natural that much of this should be linked with description of the commoner greases—the lime base cup greases and the soda base greases ; but it is equally well done though less extensively in the sections devoted to the less well-known metallic soap base greases and special compounds.

Wherever one turns there is invaluable information not obtainable elsewhere, or only with difficulty. Moreover, this is no mere compendium of abstracts. It is tied together by a man who knows this subject as an expert. Throughout it is critical and wise.

The book is in fourteen chapters, of which the first three are devoted to preliminary considerations including the nature of greases, the theory of manufacture and description of the raw materials employed. These are adequate without being outstanding. It is likely indeed that the author will modify some of his theoretical views in the future as more information is accumulated on grease structure. The chapters to which reference has already been made, *i.e.*, those on calcium base and sodium base greases, occupy nearly half the book. It is difficult to praise the treatment too highly. Every practical grease maker will owe a debt of gratitude to Klemgard for opening up thoughts and lines of work which could only come after a lifetime of individual experience.

The sections on aluminium, lead and other metallic base greases, and on organic and inorganic lubricants and special compounds, are very up-to-date and make extremely interesting reading. Test them where one will, they evoke admiration for their knowledge and the meticulous care with which they have been written. The whole treatise indeed is on this high standard and the author must be proud of its accomplishment.

The reviewer has sometimes cavilled at the cost of technical books, but this one, though expensive, is overflowing value for the price charged.

S. J. M. Auld.

Asphalts and Allied Substances. By Herbert Abraham. Fourth Edition. Pp. xxiv + 1491. Chapman and Hall Ltd., London, 1938. 60s. net.

In his preface to the third edition of this classic work, published in 1929 and reprinted in 1932, the author referred to the rapid strides made in the technology of bituminous substances during the decade which had elapsed since the appearance of the second edition.

A similar allusion could be made with reference to the six years preceding the publication of the present greatly enlarged and revised edition, for that period has been remarkable for the great increase in the number and variety of uses which have been found for bituminous materials, and for the corresponding increase in the sources of supply and in the methods and equipment which have become available for exploiting them.

It is noteworthy that the progress made in six years has been adequately covered by only 500 pages of additional matter, and this is a striking testimony to the inherent soundness of the original textual sequence, which has not been departed from, but has been expanded and brought up to date.

The work is divided into six parts which embrace 37 chapters, each of which fully bears out the assertion, made by the publishers, that no effort has been spared to make this new edition as comprehensive as possible.

The opening chapter is a historical review dealing with the origin of the words "Asphalt" and "Bitumen," and it includes a very interesting series of excerpts in chronological order, from available records relating to the use of asphalts by mankind throughout a period which extended from Sumerian times until the present century.

In this part the author has been able to include references to the valuable publications of R. J. Forbes, C. L. Wooley, F. J. Nellensteyn and H. Frankfort, which have been contributed to the literature since the date of the third edition.

Scottish readers of this section may perhaps feel that a serious omission exists in this chronology since no mention is made there, or in any part of the book, of the pioneer work of Dr. James Young, although the discovery of paraffin wax is correctly ascribed to Carl von Reichenbach, and a later chapter deals extensively with the Scottish shale industry.

Chapter II, dealing with the terminology and classification of bituminous substances, is of special importance and interest at the present time in view of the efforts which are being made by standardizing bodies to secure an internationally recognized nomenclature.

The third and fourth chapters deal respectively with the Chemistry of bituminous substances and the Geology and origin of bitumens and pyrobitumens. Although short, these chapters summarize adequately the most important theories and facts.

The annual production of bituminous substances and their manufactured products is the subject matter of Chapter V, and may be of interest to those who deal in statistical data, although it may be mentioned that in the majority of cases the recorded figures do not extend beyond the year 1935.

It would be impossible in a short review of this kind to do justice to the wealth of information which is available to readers of this truly encyclopædic work, and it is difficult to find any branch of the subject which has not been dealt with in a manner which will appeal to all those who can appreciate the vast amount of painstaking work which has been expended in collecting the requisite data.

To some hypercritical technologists it might appear that the detailed descriptions of some of the operations pertaining to the refining of petroleum go somewhat beyond the legitimate scope of a book dealing chiefly with bituminous substances.

For instance, the solvent extraction of lubricating oils, and cracking processes for increasing the yield of gasoline, would scarcely seem to need more than a passing reference as an introduction to special types of asphaltic material provided by propane de-asphalting, or by pressure tars.

On the other hand, it may be contended that if the latter substances possess any interest to the asphalt industrialist, it is legitimate to include a description of the preliminary processes which lead to their production and may affect their qualities.

A very important improvement in the present volume is the section on testing methods which has been entirely rewritten, and now constitutes 28 per cent. of the whole work. All the recognized standard methods are included and in addition a large number of others which have appeared from time to time in the literature and have been tried out in the author's laboratory. This section is a complete work of reference which will be invaluable to testing laboratories. The methods are numbered according to the author's own system of classification, but the official designations of the A.S.T.M., or other standardizing bodies can readily be obtained from the list of references at the end of the volume.

These references, with the extensive bibliography together with a comprehensive list of patents, occupy 250 pages or nearly 17 per cent. of the volume.

The book is well printed in an exceptionally clear type, the illustrations and figures, which number 333, are excellent and although somewhat bulky the volume is strongly bound, a desirable quality in a work which will undoubtedly receive extensive handling by those who are wise and fortunate enough to possess it.

J. McConnell Sanders.

BOOKS AND PUBLICATIONS RECEIVED.

Limestones of Canada. Their Occurrence and Characteristics. Part IV. Ontario. By M. F. Goudge. Bureau of Mines, Bulletin No. 781. Pp. xii + 362. 2 pocket maps. King's Printer, Ottawa. Price 75 cents.

This report deals with the occurrence and chemical and physical characteristics of the limestones occurring in Ontario. The limestones, the resources of which are abundant, range in type from the high-calcium variety to dolomite, and in purity from those containing less than one per cent. impurities to those containing 50 per cent. of siliceous and argillaceous matter. In age they range from pre-Cambrian to Devonian.

Annual Report of the Department of Lands and Mines of the Province of Alberta for the Fiscal Year ended March 31st, 1937. Pp. 79. King's Printer, Edmonton.

According to the Report of the Petroleum and Natural Gas Division, the outstanding feature of the fiscal year under review was the bringing in of the Turner Valley Royalties well. The initial production of the well was 850 barrels per day. This figure eventually settled down to 550 but with acidization was brought back to its original production rate, which has been well maintained since.

Geoquimica de los Petroleos Argentinos (Geochemistry of Argentine Petroleum). By E. Longobardi. Pp. 98. "El Ateneo," Libreria Cientifica y Literaria, Buenos Aires, 1937.

Geological details of the regions studied are given followed by a description of the usual tests on crude oils. The chemical constitution of gases from the oilfields of Comodoro Rivadavia—the mineral content of the crude oil—the discovery of vanadium in the crude oil and its relation to the other constituents of the oil—and the discovery of a new asphalt called "Kylita," are all dealt with in some detail. A section is devoted to the optical properties of crude oils and their distillates, with particular reference to those from the fields at the foot of the Andes between Tucuman and Santa Cruz in Bolivia.

Trinidad and Tobago. Report of Inspector of Mines and Petroleum Technologist for 1937. Council Paper No. 32 of 1938. Pp. 18 + 9 diagrams. Government Printer, Trinidad.

The report on the Petroleum Industry gives particulars of crude-oil production and drilling activities, together with statistics of oilfield operators, leases and licences, refineries, loading facilities, pipe-lines, storage and exports, etc.

Geology and Mineral Deposits of Tasmania. By P. B. Nye and F. Blake. Geological Survey Bulletin No. 44. Pp. v + 113. Map. Tasmania Dept. of Mines. Price 2*s.* 6*d.*

Extensive deposits of oil shale occur in northern and north-western parts of Tasmania, as beds on the horizon of the Greta coal measures of the Permo-Carboniferous system. The average yield of crude oil from these shales is estimated at 27 gallons per ton.

Many deposits of clay are known to exist but no investigation of these has been made.

Territory of Papua. Annual Report for the Year 1936–1937. Pp. 51 + Map. Commonwealth Government Printer, Canberra.

Report to the Council of the League of Nations on the Administration of the Territory of New Guinea. From 1st July, 1936 to 30th June, 1937. Pp. 166. Commonwealth Government Printer, Canberra.

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Geology.

857. Significance of Recent Illinois Basin Discoveries. G. F. Moulton. *Oil Wkly.*, 4.7.38, **90** (4), 18–24.—During Palaeozoic times the present Illinois Basin was probably the northern portion of a much larger basin. It was not until the end of the Devonian period that there was any evidence of folding, and this resulted in the limestone on the crests of the folds becoming weathered and more porous than the areas structurally lower. Deposition then continued uninterrupted until the end of Mississippian times, though the deposits varied in character and thickness in various parts of the basin. Before the beginning of Pennsylvanian times the region was subjected to extensive folding and erosion. Later, the basin was down-warped and the area of deposition gradually increased. Towards the end of this period structural movements folded and faulted the Pennsylvanian and older sediments, most of the movement taking place along the lines of original deformation. This fact makes it difficult to apply structural data, based on the Pennsylvanian, to the older horizons. A thick glacial deposit now covers the area, and geological work is hindered by the lack of good exposures.

Most of the early development in this area was located on and around the La Salle Anticline, and production was obtained from the McCloskey Sand. Since 1935, however, geophysical exploration methods have proved very successful in locating many productive structures such as Patoka, Cisne, Clay City and Noble. J. A. G.

858. Possible Producing Strata Existing below the McCloskey in Illinois. A. H. Bell. *Oil Gas J.*, 16.6.38, **37**, (5), 30, 31, 108.—The present main producing horizons in the Illinois Basin are the McCloskey Sand, the Westfield Lime, and the Martinsville Lime, all near the top of the Mississippian at a maximum depth of 3500 ft. The oil content of these horizons is probably associated with the unconformity at the top of the Mississippian, and it is therefore improbable that any large production will be found in the lower part of this series.

The underlying Kinderhook–New Albany series consists of several hundred feet of Devonian–Silurian limestones. Some oil has been produced from the Devonian in this region, and many oil shows have been encountered in the upper portion of the series. Analyses of the Devonian brines indicate that movement within the strata is not restricted and good porosity exists.

The Trenton Limestone has given a little production in the Dupo Field, St. Clair Co., but elsewhere its porosity is low. It is not known what conditions prevail in this formation to the east owing to lack of drilling.

No oil has ever been found in the St. Peter Sandstone in Illinois, but it is thought that conditions might be favourable in the centre of the basin. Under the St. Peter there is about 3000 ft. of dolomite and sandstone of Ordovician and Cambrian age. Owing to the absence of possible source-rocks, this series is not considered very favourable.

J. A. G.

859. Nebraska Bids for Oil. C. Vrang. *Oil Wkly.*, 23.5.38, **89**, (11), 18–21.—The Agate Springs Anticline lies in an embayment between the Black Hills and the Hartville Uplift. On the other side of the latter structure the Lance Creek and Mule Creek oilfields have been developed in the Sundance, Minnelusa and Madison formations. All these horizons are known to be within easy drilling depth on the Agate Springs Anticline.

The stratigraphical succession in this region ranges from the Mississippian, overlying a basement complex, up to the Tertiaries, often overlain by a Pleistocene Series.

The Agate Springs structure is now being tested by a well which is expected to reach the producing horizons before the winter. J. A. G.

860. Sparta has Possibilities in Pointe Coupee Parish. J. D. Todd and F. C. Roper. *Oil Wkly*, 20.6.38, **90**, (2), 34–35.—Geophysical work has indicated the presence of a number of structures favourable to oil accumulation in Pointe Coupee Parish, and a test-well recently drilled found a good section of upper sands, a poor Cockfield Series, and 20 ft. of Sparta Sand. The well was probably located too far down dip, or a thicker section of the latter sand would have been found.

Now that production has been found in the Sparta at Ville Platte, it is thought that one or two structures in Pointe Coupee Parish will prove productive from this horizon.
J. A. G.

861. Search for Oil in Southern Mississippi Encouraging. N. Williams. *Oil Gas J.*, 16.6.38, **37** (5), 21, 22, 36.—Discoveries in the southern portion of Mississippi have led to the belief that an old basin or embayment of the Gulf of Mexico underlies this area. The basinal structure is not apparent in formations younger than Wilcox or basal Claiborne, but it is definitely indicated by a well which entered the Wilcox 2000 ft. lower than two other wells 20 miles to the north and south respectively. The exact boundaries have not yet been fully determined, but the northern limit is believed to be the Hatchetigbee Anticline, and the southern limit is also thought to be an anticline. The eastern boundary is probably just over the border in Alabama.

Geophysical surveys have indicated the presence of several "highs," and drilling has proved two of them to be salt domes. Apart from possible salt-dome production in the middle of the basin, there is also the chance of shore-line conditions occurring on the northern limit. As the formations rise from the centre of the basin towards the coast, it is improbable that an extension of the Texas–Louisiana coastal salt domes will be found.

Although no oil shows have been noted in the wells so far drilled, the Cockfield and Wilcox are considered to be potential producers where drilled on suitable structures.
J. A. G.

862. Zenith Proves Good Sand-field in Western Kansas Lime Area. F. B. Taylor. *Oil Wkly*, 11.7.38, **90** (5), 30–32.—The Zenith Pool in Western Kansas produces from the Misener Sand. Accumulation is due entirely to lensing conditions, there being almost no indication of structure. The producing sand is stated to be composed of materials eroded from an older land surface, and contains a large amount of re-worked Simpson Sand. It unconformably overlies Hunton, Viola, Wilcox or even granite, and varies in thickness from 5 to 32 ft. Unconformable overlying it is the Chatanooga Shale, which forms a good cap-rock. A water-table exists in the sand-body, but has so far presented no difficulties.

The Zenith accumulation is not considered to be an isolated case, and search is being made for similar sand-lenses.
J. A. G.

863. Oil Deposits of Bucsani. D. Stefanescu. *Monit. Petr. roum.*, 1938, **39**, 517–522.—Bucsani is about 40 miles N.NW. of Bukarest. Drilling in 1907 led to an eruption of gas, which made further work impossible. Exploration began again in 1929.

The oil-field occupies part of the alluvial plain of the River Ialomita, and an outcrop of Levantine to the E. This outcrop, regarded as the dome of an anticline, directed attention to the possibilities of the region. The anticline runs from W. to E. Slight faults in the W. and N.E. do not much affect the oil deposits, but in the S. a longer fault limits the field, and drilling beyond this has reached salt deposits without striking oil.

Oil is found in the porous rocks of the Meotian. Oil exists at three levels in this stratum: (1) at 26–46 m. below the top surface in a mixture of sand and marl, (2) at 64–72 metres down in sandy marl, and (3) at 146–165 metres in three layers of sandstone, marl and sands. (3) is the richest by far, (1) being productive only on the axis of the anticline, and (2) not being exploited.

Wells are spaced at 200 m., and have produced so far an average of 30,000 tons of oil each. It is hoped that this will reach 45,000 tons. Some wells have been very prolific, mostly on the highest part of the anticline. The oil is paraffinic, and is of two main types, the first of density 0·815 giving on distillation 16% petrol and 26% kerosine, and the second of density 0·83 giving 13% petrol and 21% kerosine. The oil from the topmost level, however, has a density of only 0·735, and gives 59·4% petrol.

About 2½ million cu. m. of gas are emitted each day, which, after being scrubbed of oil, is burnt in the district, or sent, for lifting purposes, to neighbouring fields. Attempts have been made to rationalize production so as to make the utmost use of this gas pressure, but without marked success, and the lesson is that when a new field comes

into production, full information is necessary of the structure of the oil-bearing strata, the water, and the gas position, so that the maximum use can be made of the natural forces, whilst exploitation should begin on the outside edges of the deposit, and work inwards.

The depth of the Bucsani wells varies from 980 m. to 1980 m. Hydraulic rotary systems of drilling are used, and the withdrawal of core samples at interesting points is made possible under the Robishaw system without withdrawing the drill-rods.

The paper describes the general methods of costing adopted. The field may be extended eastward in the future. W. E. J. B.

864. Some Aspects of the Exploitation of Petroleum in Peru and Colombia. Anon. *Rev. Pétrolif.*, 29.4.38, (783), 539–540.—The Peruvian oil production has been rising since 1932 and amounted to about 18,000,000 brls. in 1937. The oil from seepages was first used in the sixteenth century, and systematic exploitation began in 1870, although with little success at first. The main oil concessions lie in a narrow belt along the coast, and oil is apparently obtained from Tertiary beds. Some wells have been taken down to the Cretaceous. The productive horizons range from 300 to 4700 ft. in depth. Gas conservation is practised, and 60% of the gas is now returned to the formations.

During 1937 the oil production of Colombia exceeded 20,000,000 brls., having been rising since the depression. Exploitation is much more difficult than in Peru, due to lack of easy access to the petroliferous areas. Oil is obtained from Tertiary beds on anticlines at Infanta and La Cira, there being three producing horizons at La Cira and two at Infanta. About 840 wells have been drilled, the depths ranging from 1000 to 2000 ft. at La Cira. 80% of the oil is obtained by pumping, and except for drilling, electricity is universally used for power purposes. G. D. H.

865. Search for Oil in Languedoc. Thoral, Estival and Dreyfuss. *Rev. Pétrolif.*, 13.5.38, (785), 605–607.—Samples of the Auzon asphalt deposit have been shown to be polymerization and oxidation products of petroleum.

Some authors believe that the Gard asphalts may have been formed in lagunolacustrine Oligocene beds, and then migrated into subjacent beds. This hypothesis assumes that the Oligocene covered all the Bas-Languedoc area, and that it was petroliferous or asphaltic at all points where bitumen is now found; that the hydrocarbons descended into the Cretaceous beds of Pli de Nîmes and into the Jurassic on the S.E. margin of the Cevennes, and that erosion has removed much of the Oligocene. Outcropping asphalt indications are widespread in Bas-Languedoc. The first series of bituminous beds is in Liassic limestones and dolomites in the Vallée de la Vis and that of Hérault. The second series is found on the S.E. margin of the Oligocene basin of Alès and at Auzon. At the latter place the age is Hauterivian. The third set of oil indications is much farther S.—the asphalts of Milhaud and the hydrocarbon gases which escape from fractures in the Lower Cretaceous of Pli de Nîmes. No signs of Oligocene beds occur within several kilometres of this point, and where found they are neither asphaltic nor petroliferous, and do not appear to have been so. It should be noted that the CO_2 seeps of Bouillens de Vergèze (Gard) contain methane and higher paraffins with only traces of hydrogen. In the bulk of the cases the evidence as a whole does not support the hypothesis of an Oligocene origin for the asphalts and other hydrocarbons of Bas-Languedoc.

The second hypothesis postulates pre-Liassic petroliferous beds from which oil migrated along fractures and became polymerized, oxidized and changed by sulphur, yielding the asphalts of the Gard and the hydrocarbons around Vergèze. All the hydrocarbon indications are near the great lines of faulting affecting Bas-Languedoc.

At Gabian a little oil has been found in Middle Triassic dolomitic limestones, and near Gorniès a seepage was met in a dolomite (probably Rhetic) some metres from the Triassic and near a large fault. A well being drilled at Castelnau-de-Guers entered the Jurassic at about 760 m., and has shown traces of oil in cores. Other wells are to be drilled.

Between the great faults of Bas-Languedoc is a series of anticlines, trending about N.–S. and E.–W., with undulating axes. The strings of domes thus formed are favourable for oil accumulation. G. D. H.

866. Search for Oil in Australia in 1937 Reviewed. A. Wade. *Petr. Times*, 14.5.38, **39**, 617–620, 629.—Various Acts have been passed to aid well-conceived search for oil in Australia.

One interested group has carried out drilling at two locations in Queensland and two in New South Wales, in addition to geological and other work in Papua and New Guinea. At Hutton Creek, Queensland, a well was in the Permian (Middle Bowen) at 3715 ft. To the N. at Arcadia a well was in the Permian at 4110 ft., and had found many shows of " wet " gas from 1315 ft. downwards. A flow of some 2,000,000 cu. ft./day at 350 lb./in.^{2} was observed, but the gas contained a large proportion of carbon dioxide.

At Kulnara, New South Wales, a well has reached 5669 ft., having found unexpected thicknesses of Permian, and at Mulgoa, W. of Sydney, a well has been drilled to 3125 ft. Both have been shut down.

There has been new work N.E. of the old gas wells of the Roma area, and the 1931 well on re-opening gave a little good oil with much water. This well has been shown to be in a syncline, and geological investigation has revealed a broad, oval dome in Upper Jurassic–Lower Cretaceous beds. A well near Lakes Entrance has yielded over 200 gals. of heavy oil per day from glauconitic Oligocene sands at a depth of 1259 ft. The oil was associated with much water. A well at Sale, 50 ml. S.W. of Lakes Entrance, failed to find the glauconitic sands. A buried shore-line is being sought in the Oligocene W. of Lakes Entrance.

In New Guinea suitable structures have been located in Tertiary beds. In Papua, also, good structures have been found in Tertiary beds, and great thicknesses of oil-impregnated sediments associated with them have been studied. G. D. H.

867. Search for Oil in Papua. Anon. *Petr. Times*, 16.7.38, **40**, 70–72.—A series of *en echelon* structures are known—Oiapu anticline, Jokea–Apinaipi dome, Apinaipi anticline and Lesi anticline. The Oiapu structure has certain very favourable features, and work has therefore been transferred to it, since it is likely to afford the most geological and palaeontological information for the least time and money. It also seems to have the best chances of being oil-bearing.

The average width of the Oiapu structure is over 1 ml. It is at least 7½ ml. long, with a closure of 600 ft. and a closed area of 5000 acres. The middle calcareous group immediately overlies the mudstone group in this area, and was laid down under shallower marine conditions than corresponding beds at Apinaipi. In general, the indications point to shallower water conditions at Oiapu than farther N., and it is possible that this area represents barred-basin conditions. The dips are 35° on the S.W. flank and 25° on the N.E. flank.

The Jokea–Apinaipi dome is a smaller structure, and would be more expensive to develop. On it No. 1 bore reached 509 ft., showing dips of 45° in tuffitic clay silts with occasional fine sandstones. Shows of gas were noted throughout, and some indications of live oil. No. 2 was near a gas-blow. This reported a pressure of 250 lb./in.^{2} and live oil at 444 ft. and 473 ft. The structure has evidences of faulting, but its closure has not been determined on.

On the Apinaipi anticline the mudstone series is not exposed. Further work is required here.

There are signs of other favourable structures, but they require examination. The whole area is underlain at various depths by a mudstone series which is known to be petroliferous in other parts of Papua, although its commercial value is unknown for lack of tests. On Oiapu there are signs that almost all the conditions are favourable for the presence of oil, except that beds of sufficient porosity are not yet known to be present. However, the indications of shallow water or barred basin conditions make it reasonable to expect these. G. D. H.

868. Oil Found in " Anglo-American's " Scottish Well. Anon. *Petr. Times*, 2.7.38, **40**, 11–12.—Midlothian No. 1 had been drilled to a depth of 3857 ft. when it entered the Old Red Sandstone, and further drilling was abandoned. It was decided to test the various possible producing horizons revealed by mechanical cores and Schlumberger electrical logging. The most promising lay at 1733–1760 ft., and a cement plug was therefore set at 1811–1850 ft. The hole was reamed and casing was set and cemented at 1700 ft. After running an over-size bit to scrape mud from the sand surface, tubing was run and the Christmas tree fitted. Water was circulated for several hours, and then

swabbing was begun. After swabbing down to 1100 ft. the casing pressure was 280 lb./in.², and a little later gas blew the liquid out of the hole. Repeated swabbing gave 15 brls. of liquid (50% oil) in the first 24 hr., and towards the end the oil content was 70–75%. Swabbing is to be continued in an attempt to eliminate water, as this is thought to be from the drilling mud. Later the well may be shot.

The oil has a specific gravity of 0·823. G. D. H.

869. New Oilfield in Egypt? Anon. *Petr. Times*, 28.5.38, **39**, 700.—At Ras Gharib, a point on the Red Sea coast midway between Suez and Hurghada, a well, on cleaning out at a depth of 2500 ft. and testing, gave 2044 brls. of oil with 3½% of water. The specific gravity of the oil was 0·923. Further wells and a longer test will be required to prove the real importance of the discovery, but already additional plant is being installed. The regulations prevent the raising of oil except for prospecting purposes until a mining lease has been granted. This is expected to be a mere formality, since the early stages of the regulations have been completed in a proper manner.

G. D. H.

870. Shoestring Trend Akin to Offshore Sand-bars. D. Dalymple. *Oil Gas J.*, 23.6.38, **37** (6), 33, 34, 92.—The shoestring fields of E. Kansas have been examined with the object of discovering the origin of the sand-bodies. It is believed that they were deposited on the edge of the ancient Cherokee Sea, the shore-lines of which extended S.E. and S.W. from near Madison in Greenwood Co. The sand-bodies vary in size up to 7 miles in length and 1½ miles in width. They occur in several trend-lines, which indicates that the shores of the sea migrated, and when migration temporarily ceased, a new line of lenses was deposited parallel with the previous shore-line.

The sand-bodies are surrounded by fine-grained shale, which effectively prevents migration on a regional scale. It is suggested that the oil was probably formed from the abundant organisms which would thrive in the lagoonal conditions just off the shore, and once formed, it would not migrate far, but enter the nearest sand-body and remain entrapped.

Further extension of these shore-line conditions in a southerly direction is quite probable, and, after passing out of Oklahoma, swing northwards again in the direction of Nebraska. J. A. G.

Geophysics.

871. Correlation of Beds in a Cased Well by a Thermometric Method. M. Schlumberger and A. Poirault. *Rev. Pétrolif.*, 29.4.38, (783), 537–538.—Electrical coring is possible in uncased holes only. It is, however, very important to be able to recognize beds behind casing, for in many fields, where the rich deep beds were first exploited, shallow sampling was neglected for speed and economy, and electrical coring was unknown. Thus there are many wells with productive sands cased off at points which are not known accurately. Thermometric studies permit these points to be determined.

A well is more or less in thermal equilibrium with the surrounding beds. This equilibrium is disturbed by the circulation of mud, which is warmer or cooler than the surrounding beds, and then the temperature changes in the mud are studied a few hours after circulation has been stopped. With a cold mud the heating will be most rapid where the surrounding beds are the best conductors of heat. Permeable beds differ from impermeable beds in this respect, for they are the seat of convection currents, and so readily transmit heat to the well. Hence the mud is heated more quickly opposite permeable than opposite impermeable beds.

A resistance thermometer is used and a continuous record is taken in the well. The results of a test in Roumania are shown. G. D. H.

Drilling.

872. Diesel Engines Finding Wider Use as Power for Drilling. M. Tucker. *Oil Gas J.*, 19.5.38, **37** (1), 80.—The development of power or mechanical rigs has simplified the adaptability of diesel power to drilling. Diesels are now drilling wells up to depths of at least 7000 ft., and are used on unitized or machine spudders and cleaning-out or pulling units; on portable and unitized cable-tool rigs capable of drilling 5000 ft. or more; on half or full electric rigs driven by diesels; and for all drilling-in purposes.

Diesel mechanical rigs have resulted in four improvements in their development for suitability as oil-well drilling units :

1. Flexibility and acceleration while operating under all ordinary and emergency conditions.
2. Dependability and stamina over long operating periods.
3. Economy of operation and maintenance.
4. Portability.

Modern diesels have a range of r.p.m. of from 380 to 400 at idle speed to 800 to 850 at full speed.

High torque at low speeds enables a long string of drill pipe or casing to be picked up and pulled with rapid acceleration. Little variation of torque occurs between the speed range of 400–800 r.p.m. This slight variation in torque between idle and full speed has made the diesel engine readily adaptable to the power requirements in rotary drilling. L. V. W. C.

873. Well Depth Measurements—Part I. C. E. Reistle, jun. and S. T. Sikes, jun. *Oil Wkly*, 13.6.38, **90** (1), 41.—Three fundamental problems arise in a study of well-depth measurements :—

1. Some standard method of measuring vertical distance below the earth's surface that will be accurate and reliable.
2. The most accurate method of measuring tubular goods into wells, and
3. The correlation and relative accuracy of special measuring devices employed in the measurement of well depth.

Relative depths which may be accurately reproduced are as satisfactory as absolute depths, and of more importance is the ability accurately to locate at will any sub-surface point in the well using drill-pipe, sand-line, special measuring devices, casing or tubing. L. V. W. C.

874. Well-depth Measurements—Part II. C. E. Reistle, jun. and S. T. Sikes, jun. *Oil Wkly*, 20.6.38, **90** (2), 40.—The determination of the stretch of a mixed string of tubular goods is considered, and various errors in measurement and their correction are discussed. L. V. W. C.

875. Good Drilling Practice—Part II. J. Bayliss. *Oil Wkly*, 23.5.38, **89** (11), 29.—The author continues his discussion of time and expense-saving methods in the drilling of wells, and this article covers drilling, spudding, straight holes, coring, casing and cementing. L. V. W. C.

876. Practical Dynamometer Tests. H. N. Marsh and E. V. Watts. *Oil Wkly*, 6.6.38, **89** (13), 29.—The authors show the place of the dynamometers in well-testing problems, testing the principal types and presenting data on the accuracy of the hydraulic type. Uses of dynamometer data are outlined and field and office procedure is described.

A number of nomograms are given, and examples of various wells are cited. L. V. W. C.

877. Evaluation of Filtration Properties of Drilling Muds. M. Williams and G. E. Cannon. *Oil Wkly*, 20.6.38, **90** (2), 25.—The filtration of mud is determined primarily by the amount and nature of solids present, and the addition of weighting materials ordinarily increases the rate of filtration. The factors influencing the filtration rate are : degree of dispersion of solid, distribution of particle sizes, degree of hydration, and presence of dispersing or agglomerating agents. A preponderance of highly hydrated colloidal material, with a wide range of particle size, and the presence of a dispersing agent are conducive to the lowest rate of filtration.

The method of presentation of laboratory filtration data is given by which the individual factors determining filtration may be isolated, and evaluated and the significance of each factor is discussed. L. V. W. C.

878. Drilling Patents. I. Thomas. U.S.P. 2,118,242, 24.5.38. Latch for casing cutters. C. B. Holt. U.S.P. 2,118,350, 24.5.38. Joint for rotary drill pipe.

J. A. Zublin. U.S.P. 2,118,542, 24.5.38. Fluid operating drilling bit, in which impinging fluid causes rotation.

R. E. Lee. U.S.P. 2,118,650, 24.5.38. Well-drilling mechanism consisting of a series of flexible units with a deflector at the lower end to direct the stem through an opening in the casing, and means for locking and unlocking the lower end in a predetermined angle.

J. J. Grebe. U.S.P. 2,118,669, 24.5.38. A method of treating formations by introducing an aqueous electrolyte comprising a heavy metal ion and electrolysing the solution on site to deposit metal from the solution.

E. F. Raymond. U.S.P. 2,118,982, 31.5.38. Rotary jar.

G. F. Turechek and E. R. Smith. U.S.P. 2,118,991, 31.5.38. An electrohydraulic fishing tool.

C. M. Brummett. U.S.P. 2,119,095, 31.5.38. Directional drilling device, with means for swinging the bit to incline in a vertical plane when the bit strikes bottom.

J. A. Zublin. U.S.P. 2,119,618, 7.6.38. An over-size hole-drilling bit.

J. J. Whalen. U.S.P. 2,119,661, 7.6.38. Rotary drag-bit.

W. A. Abegg. U.S.P. 2,119,731, 7.6.38. Drill-pipe slips.

E. K. Lane. U.S.P. 2,119,746, 7.6.38. Whipstock anchor with means for lodging and dislodging the tool in the hole.

S. Siracusa. U.S.P. 2,119,797, 7.6.38. Slip-type releasing socket.

C. P. Parsons. U.S.P. 2,119,829, 7.6.38. Method of preventing loss of drilling fluid into openings in the well wall, which consists of incorporating in the drilling fluid sugar-cane fibres that have been substantially desugared.

H. G. Blevins. U.S.P. 2,120,062, 7.6.38. Welded butt-joint for well casing.

R. R. Hawkins. U.S.P. 2,120,132, 7.6.38. A method of cleaning out a well by mechanically loosening up the detritus, causing a chamber to be filled with the detritus, forcing this detritus to the surface by means of artificially produced gas pressure, and repeating this operation until the well is cleaned.

W. Schwenlein. U.S.P. 2,120,224, 7.6.38. Derrick structure.

J. F. Chappell. U.S.P. 2,120,240, 14.6.38. A drilling apparatus comprising a rotatable drill pipe, through which an expanding bit can be lowered, and means for imparting a hammering motion to an inner bit.

R. S. Hyer. U.S.P. 2,120,670, 14.6.38. Method and apparatus for orienting tools. The lower end of the string carries a magnet and an instrument containing means for indicating azimuth, a magnetic compass and means for recording the indications of azimuth indicating means and the compass.

E. C. Cowell. U.S.P. 2,120,694, 14.6.38. Apparatus for cementing oil wells.

L. V. W. C.

Production.

879. Conservation of Gravity in the Production of Oil. S. F. Mauncy, jun., and G. M. Vandaveer, jun. *Oil Wkly*, 30.5.38, **89** (12), 18.—Estimates are given showing the gravity and volume losses of crude petroleum occurring in the Mid-Continent area, including savings made possible by gravity conservation work.

Certain methods have a direct or an indirect effect on the gravity of the produced oil. In some instances losses caused by production methods are partly recovered in

gasoline plants, but it is generally more profitable to retain as much gravity, with consequent connected volume, in the crude as possible.

Gravity conservation goes hand in hand with low gas/oil ratios, and in natural-flowing wells some control can generally be exercised over the rate of flow.

A general decrease of gravity is shown when oil is produced by gas-lift. Entrance of water into wells has a marked effect on gravity, irrespective of the method of production due to the formation of emulsions which have to be treated.

Pipe-line losses are incurred by air that is allowed to enter gravity-gathering systems and then later expelled with the load of vapours at the gathering-stations. The filling of cone-roof tanks is another pipe-line transportation loss. L. V. W. C.

880. Removing Excessive Moisture and Production Water from Gas. Anon. *Petrol. Engr*, June, 1938, **9** (9), 38.—On an Oklahoma oil-field lease excessive moisture is removed from the gas before it enters the pipe-line by connecting one branch of the Christmas tree to a vertical separating column consisting of 20-in. pipe, containing a single baffle about two-thirds up, below which the gas enters. The separated water is drawn off from the base of the column into a horizontal reservoir, which is blown at intervals into an evaporation pit. C. L. G.

881. Problems in Modern Deep Pumping. C. J. Coberly. *Oil Gas J.*, 12.5.38, **36** (52), 126.—Important problems will result from the pumping of wells below 7500 ft., and the author deals with these and states the limitations of the present pumping methods with reference to the equipment customarily employed in pumping.

The transmission of power through an oscillating pump-rod involves many invariables, some of which cannot be fully controlled. The effect of others may be observed on the action of the pump, but are difficult to predict because of the lack of a complete rational solution.

Some approximate analyses of the sucker-rod problem, which may be applied to the selection and operation of pumps of the sucker-rod type, are given.

Stresses due to the weight of the rods, dynamic loading and the maximum horse-power of the rod string are considered.

From the analysis of sucker-rod performance certain conclusions are reached. Among these are that rods designed for uniform stress are capable of carrying heavy fluid loads, 95 h.p. per sq. in. of rod can be transmitted by a tapered string with a stress of 30,000 lb. per sq. in., a stroke length of 100 ins., and at a speed which gives an acceleration of 56% of gravity; rods of uniform cross-section will not carry heavy fluid loads in deep wells, etc.

Other pumping problems considered are corrosive water, gas separation, sand viscosity and bottom-hole pressure. L. V. W. C.

882. Bottom Hole Pressures in Current Oil-well Operations. C. V. Millikan. *Oil Wkly*, 30.5.38, **89** (12), 41.—Although pressure and fluid levels have always been used in the operation of oil wells, the measurement of effective bottom-hole pressures is new. Present-day work is directed towards the operations of the field as a whole. Oil is produced as a result of pressure differences between the producing formation and the bottom of the hole, and the pressures are basic. Any operating procedure depends on these pressures for its accomplishment. The reservoir condition can be determined by the aid of bottom-hole pressure measurements, as can the condition of the screen or liner. Pumping-well problems are solved by bottom-hole pressure measurements by giving data which will prove whether the amount of fluid which is being produced is limited by the ability of the well to produce or the ability of the equipment to lift the available fluid. In fact, every condition of the reservoir, in the hole or in the equipment which affects the rate of production will affect the bottom-hole pressure. L. V. W. C.

883. Pressure Maintenance. E. O. Bennett. *Oil Wkly*, 30.5.38, **89** (12), 23.—Pressure maintenance is defined as the practice of returning gas to the oil-producing formation for the purpose of maintaining reservoir energy and pressure. The value of pressure maintenance has been proved, but it is utilized by relatively few operators. Among its advantages may be stated: saving of gas for fuel that would otherwise

be wasted; providing energy to produce oil naturally, thus eliminating pumping equipment; prevention of water encroachment; increased life in gasoline plant operations; great increase in ultimate recovery of oil and reduction in gas-oil ratios. Operations and equipment are dealt with. L. V. W. C.

884. Reworking of Water Wells in East Texas Gaining Momentum. J. Weber. *Oil Gas J.*, 12.5.38, **36** (52), 116.—One of the principal current studies of many East Texas engineers is rapid salt-water encroachment. During 1937 a gain of over 60% in the number of wells making water, with a total daily water production nearly doubled, has brought the problem to the attention of operators.

The methods of checking the increasing threat to production take three general forms. The marginal wells making high percentages of salt water may be plugged and abandoned, the salt water may be returned to the lower Woodbine sand, either at the point where it was originally produced or along a strip of wells a short distance from the production limits of the field, or the back-water wells may be plugged in an effort to maintain oil production at a lower salt-water displacement rate.

None of these general approaches alone is considered sufficient. If the present rate of increase in water withdrawal is to be checked to any extent, many of the salt-water wells beyond improvement will doubtless be abandoned.

The methods of plugging back and squeeze cementing are dealt with in some detail. L. V. W. C.

885. Production Patents. W. J. Dunlop. U.S.P. 2,118,176, 24.5.38. Well washer for attachment to deep well pump.

W. N. Huff. U.S.P. 2,118,307, 24.5.38. Rodless fluid-operated pump.

E. Dutch. U.S.P. 2,118,376, 24.5.38. A method of axially extending a main pipe-line under pressure at a closed or dead end.

W. J. Gourley and F. H. Barney. U.S.P. 2,118,377, 24.5.38. Well-pumping device.

A. M. Chrisman. U.S.P. 2,118,428, 24.5.38. A device for controlling the flow of fluid through the wall of a tubing string.

P. Cavins. U.S.P. 2,118,458, 24.5.38. Suction boiler.

C. S. Crickmer. U.S.P. 2,118,497, 24.5.38. A well-tubing catcher.

F. E. Scheider and J. C. Hinkle. U.S.P. 2,118,539, 24.5.38. Well-pumping device in which two concentric columns substantially counterbalance each other, means for alternately applying pressure to the top of these columns, a plunger operative adjacent to the lower ends of the lines to separate the columns and to transmit the forces from one column to the other.

C. C. Carlisle. U.S.P. 2,118,547, 24.5.38. Deep-well fluid motor.

F. A. Thaheld. U.S.P. 2,119,252, 31.5.38. Well swab.

G. M. Wells. U.S.P. 2,119,563, 7.6.38. Method of flowing an oil well by inserting into the sand a void forming sub-divided material having a specific gravity of at least twice the specific gravity of the petroleum-bearing stratum, and then washing the well to remove the drilling fluid.

C. J. Coberly. U.S.P. 2,119,736 and 2,119,737, 7.6.38. Governed fluid operated pump.

R. A. Wilson. U.S.P. 2,119,763, 7.6.38. Tubing catcher.

W. F. Hall and J. A. Lowrey. U.S.P. 2,120,464, 14.6.38. Well-shooting apparatus.

F. King. U.S.P. 2,120,615, 14.5.38. Well-gun perforator. L. V. W. C.

Transport and Storage.

886. Coating and Wrapping Line Pipe at Centralized Plants. F. H. Love. *Petrol. Engr*, June, 1938, **9** (9), 33.—The use of centralized pipe-line coating and wrapping plants offers advantages over field application in reducing "holidays" in the coating, waste of coating material, and in enabling the work to be carried out irrespective of weather conditions. A description is given of the equipment used at a central plant in Houston, similar portable plants being established where required. The pipe is first freed from rust and mill scale in a mill-type machine equipped with conventional cutters and wire brushes to which is attached a priming head. The primed pipe is dried for 1 to 2 hrs. on racks, and then placed on back-table rubber rollers, which can be adjusted to fit the size of the pipe. The rollers are arranged to give the required forward spiral movement to the pipe for the different sizes of wrapper used. As the pipe passes over the working pot it is supplied with hot bitumen at 400–475° F. from hoppers, one for each coat, two being generally used. Surplus bitumen falls into the heated pot below and is returned to the hoppers. The feet and paper reels are so placed that the wrappers can be applied immediately after the hot coating, which is about 3/32 ins. in thickness. The pipe is then placed on well-padded racks to avoid damage to the coating. For plants set up in the field when 6-in. pipe or larger is being coated the plant is usually dismantled and rebuilt after about 10 miles of line has been laid, three days being required for dismantling and reassembling.

C. L. G.

887. Pipe-line Coatings and Cathodic Protection. D. Harrell. *Petrol. Engr*, June, 1938, **9** (9), 90.—A discussion is presented of the sources of galvanic currents on pipe-lines, the factors affecting the choice of protective coatings and of the type of unit preferred for cathodic protection of the line. The first step in the protection against long line currents, currents around an insulated sleeve or local galvanic currents is to bond the joints with heavy copper wire and then to reverse the flow of current so that it flows from a remote anode to the pipe. A voltage drop of $-0{\cdot}24$ volt is considered the minimum for adequate protection. The quantity of current fed from the anode depends on the area exposed, the specific resistance of the anode, the area of the pipe, the resistivity of the soil, the resistance of the feed-wires, pipe and the internal resistance of the current generator and, finally, on the condition of the coating on the pipe. An example is given of a pipe with a good coating which was adequately protected with a current of 0·000257 amp. per sq. ft., whereas another with a coating in bad condition required about 20 times as much. A bare pipe required about 113 times as much. In view of the importance of the completeness of the coating, much attention has been paid to the use of holiday detectors and to the methods of application of the coating.

High-melting-point pitch enamels are considered too brittle for small-diameter pipes, fluxing to 165–175° melting point being considered desirable, followed by a durable shock-proof wrapper. For temporary small-diameter lines and leak repairs or large-diameter lines an asphalt-grease coating is recommended. The economics of pipe-line protection depend on the time the line is to be in position, as with temporary gathering systems a 2- or 3-year protection can be afforded by a cheap coating and cathodic protection, whilst an expensive pitch enamel should last 15 years if adequately protected.

For permanent lines the use of expensive coatings and cathodic protection is recommended. For practically bare lines a 5- to 8-year life renders electrical protection worth while. In general, it appears that $5 spent on cathodic protection over a period of 10 years would save $8 in the removal and reconditioning of the line. These estimates are substantiated by leak frequency curves on a mile section of 16-in. pipe taken from 1934 to 1938, which was given cathodic protection in 1936. The expense of cathodic protection is considered to be more than justified. C. L. G.

888. Earth Resistivity Measurement. L. M. Goldsmith. *Petrol. Engr*, April, 1938, **9** (7), 68.—A description is given of a Megger ground tester which has been in use since 1931 for earth resistivity measurements, this test having been found the most reliable for the detection of corrosive areas. As a result of the investigation work

carried out, which included also chemical analyses of soils and waters, it has been the practice to protect the pipe-lines in areas where the soil shows a resistivity less than 2500 ohms per c.c., or an acidity greater than 500 pts. per million, calculated as H_2SO_4, and in ponds and streams where the water shows any trace of acidity. After the lines have been laid, changes in the soil are followed and tests made with recording millivoltmeters. Since 1931 no failures of pipe due to soil corrosion have been experienced. In high-resistivity areas a cold coat pipe-line paint is used, and in low-resistivity areas a priming coat and two applications of hot dope are applied, followed by a tar-impregnated felt wrapper while the second coat is still soft. C. L. G.

Crude Petroleum.

889. Bureau of Mines Analyses, Ramsey Pool, Payne Co., Oklahoma, Crude Oil. Anon. *Petrol. Engr*, April, 1938, **9** (7), 96.—The crude oil from the discovery well in the new Ramsey Pool, Payne County, Oklahoma, is an intermediate base oil similar to that produced from the Wilcox sand in the Seminole, Oklahoma, area. A sample tested by the Bureau of Mines had a specific gravity of 0·811, sulphur content of 0·18% and viscosity S.U. at 77° F. of 37 secs. and at 100° F. 36 secs. On Hempel distillation it gave the following yields of products: light gasoline 15·0%, total gasoline and naphtha 39·0%, kerosine 9·9%, gas-oil 14·0%, non-viscous lubricating distillate 8·5%, medium lubricating distillate 5·7% and residuum 18·2%. C. L. G.

Gas.

890. Patents on Gas. H. T. Ringrose. E.P. 484,194, 2.5.38. Apparatus for indicating the presence of inflammable vapours or gases. W. S. E. C.

Refining and Refinery Plant.

891. Refining of Pennsylvania Oils by Propane Process. W. B. McCluer, J. T. Dickinson and H. O. Forrest. *Oil Gas J.*, 31.3.38, **36** (46), 113.—About 3 years ago Kendall Refining Co. commenced a study of methods of refining Pennsylvania oils with the four objectives:—

(1) Decreased cost of dewaxing; (2) improvement in dewaxing yields; (3) decrease in cost of decolorizing; (4) increase in capacity of decolorizing plant.

As a result, dewaxing and de-resining in propane solution were found to be the most satisfactory process.

Laboratory tests showed that a yield of 86% of dewaxed cylinder stock of 0° F. pour test could be obtained, and that by removal of about 3% of resins, the filter yield could be doubled. It was found best to use a propane ratio of 10 to 1 for de-resining at a temperature of about 150° F., also that the percolation costs with de-resined oil were half those currently obtaining. In dewaxing reduced neutral, it was found advisable to use about 3% petrolatum from propane dewaxing of residuum, in order to give a dense type of cake and increase the yield of dewaxed oil. In this way 82% of dewaxed 0° F. pour test oil was obtained.

As a result of the laboratory experiments, a commercial plant was installed having a design capacity of 1045 brls. a day when dewaxing and de-resining cylinder stock, and 1100 brls. a day when dewaxing neutral. The general operation of the plant has already been described (Brown, *Oil Gas J.*, 25.3.37), and many of its important features are similar to those of the Shell Petroleum Corporation plant at Wood River. The plant has been operated primarily for production of zero pour-test bright stock, with removal of a small amount of resins, but has also produced + 20° F. pour-test bright stock with small resins removal and zero pour test bright stock with large resins removal. In addition, it has produced − 5° F. pour-test neutral oil, and has operated successfully on dewaxing intermediate or slop cuts to produce zero pour-test oils. The plant has given satisfaction on all these stocks, and the ease of changing from one stock or method of processing to another has demonstrated the flexibility of the propane plant. On test the plant has met all of its guarantees, and results of operations on cylinder stocks and reduced neutral, with details of change per day, yields and properties of dewaxed oils, de-resined oils and of resins are given with operating details.

Laboratory data on decreased clay requirements and increased capacity of the decolorizing plant were confirmed. When the plant was operated to remove 3–4% of resins from dewaxed bright stock, decolorization of 680 brls. a day with a clay consumption of 80 tons was achieved. Previously the clay requirement was about 90 tons a day for 350 brls. of bright stock. The separation of neutral wax from the petrolatum used as filter aid when processing reduced neutral has proved simple, and only a small amount of fractionation is required. The slack wax has been sweated commercially to produce 57% of 124–126° F. A.M.P. wax, or 49% of 132–134° F. A.M.P. wax. Direct operating costs are estimated at 25–30 cents per brl. of charge for bright stock treatment and 18–23 cents per brl. when dewaxing only, as in the case of neutrals, for a plant of the capacity mentioned. R. A. E.

892. Packed Contact Towel Efficient in Solvent Treating Pennsylvanian Lube Fractions. B. L. Heath and D. B. Williams. *Nat. Petrol. News*, 29.6.38, **30** (26), R. 318.—As an alternative to the usual series contacting in a number of separate stages extraction has been carried out in a 67-ft. (5 ft. 6 in. diameter) tower packed with 1-in. O.D. carbon Raschig rings. The solvent used was "Chlorex." Working on Pennsylvanian neutral, unfinished bright stock and steam-refined cylinder stocks, it is claimed that the tower is equivalent to eight separate stages. The tower obviously represents considerable economies in regard to ground-space occupied, pumps, float controls, etc. H. G.

893. Filtering with Bauxite Produces Economies in Lube Processing. Anon. *Nat. Petrol. News*, 30.4.38, **30** (16), R, 195.—In comparing bauxite with fuller's earth as decolorizing agents for lubricating oils, bauxite is claimed to be superior on several points. (*a*) It produces the better product, as is demonstrated by lower carbon residue, higher A.P.I. gravity, higher viscosity index and greater stability to oxidation. (*b*) It may be reactivated by burning for a much longer period. (*c*) Its efficiency on a volume basis is higher. However, it requires a higher temperature—1200–1400° F.—in the reactivation process. The following figures were taken from a test run in which the oil was passed through two filters of capacity 275 cu. ft. and charged with bauxite and fuller's earth respectively:—

	Bauxite.	Fuller's Earth.
On stream, hours	41	24
Total cycle	104	87
Ratio on stream/cycle	0·394	0·276
Filter yields		
Brl./hr. filtering time	1·1	1·1
Brl./hr. cycle time	0·432	0·305
Per cent. increase in capacity	41·7	

H. G.

894. Continuous De-asphalting, De-resinizing and De-waxing by the Sun–Alco Propane Process. M. B. Cooke, E. Petty, and P. Barton. *Nat. Petrol. News*, 30.4.38, **30** (16) R, 186.—In the process described, the charging stock is diluted with up to 5 vols. of propane. 90% of the refrigeration is supplied indirectly, the final reduction in temperature being achieved by evaporation. The structure of the precipitate is controlled to the condition for optimum filtering rates by adjustment of the propane/oil ratio and the chilling rate. The precipitated asphalt is said to act as a filter aid in increasing filtering rates. With Mid-Continent stocks a topped residuum is used, but with Pennsylvanian stock a waxy distillate and a steam-refined cylinder stock are treated in parallel. With the latter stock the distillate is diluted with 10–20% propane, and a further 80% propane, previously auto-cooled to minus 45° F. is injected. H. G.

895. Chemical Correction of Water Used in Cooling Systems. L. D. Betz. *Oil Gas J.*, 21.4.38, **36** (49), 60.—The three main methods for the treatment of condenser water to prevent scale formation are: (1) sulphuric acid and aeration, (2) lime treat-

ment, possibly coupled with soda ash and (3) zeolite treatment. These methods have been investigated for the correction of water containing a high percentage of calcium bicarbonate in use for cooling purposes at a large mid-Continent refinery.

Sulphuric Acid Treatment.—Sufficient acid should be added to reduce the alkalinity from 200 to 40 p.p.m., expressed as calcium carbonate, maintaining an adequate pH value to reduce corrosion. The cost is given as 1·3 c. per 1000 gals. of make-up water, a proportional type of feeder, actuated by a line meter, costing about $250 to $225 being used. In the treated water the calcium sulphate formed is equivalent to 1140 p.p.m., which is below the maximum solubility (1700 p.p.m.), while the corresponding silicate (61 p.p.m.) is also below the maximum limit of 90 p.p.m. Magnesium silicate will tend to deposit from solution, while the presence of oxygen may tend to promote corrosion. To prevent the breakdown of the residual alkalinity, an inhibiting agent—a reactive organic colloid—is added at the rate of 0·1 lb. per 1000 gals. The equipment required for this should not cost more than $100, the total treating cost amounting to 3·23 c. per 1000 gals. of make-up water.

2. *Lime Pretreatment.*—For the water in question the theoretical requirement of 1·33 lb. hydrated lime per 1000 gals. is insufficient, as it makes no allowance for precipitation of the magnesium salts. This quantity will cost 1·33 cents per 1000 gals. to which must be added 0·87 cent for the 0·125 lb. sodium aluminate, which should be added to aid in the coagulation and settling of the precipitate. Including subsequent treatment with reactive colloids, a total cost of 4·10 cents per 1000 gals. is reached. In addition, a large capital outlay is required for a 120,000 gal. settling-tank and two 8 × 12 ft. horizontal type filters.

3. *Zeolite Treatment.*—For the treatment of this water containing 22 grains per gal. average hardness (460 p.p.m.) 13·5 lb. salt are required for regeneration of the Zeolite at a cost of 8·1 cents per 1000 gals. Green sand requirements would amount to 7200 cu. ft. for the filtering of 720,000 gals. per day at a cost of $28,800. The equipment for filtration and the zeolite unit would probably cost from $7000 to $10,000, requiring, with the cost of the sand, a capital outlay of $36,000 to $39,000.

Details of the analyses of the water before and after the different treatments, and of the distribution of the water in the refinery, are given.

Although it is impossible to generalize on the treatment of cooling waters, in the case of water of this type the treatment with sulphuric acid, preferably with the subsequent treatment with reactive colloids, appears to be the cheapest method.

C. L. G.

896. Laboratory Control of Distillation Equipment and of Desalting Processes. L. L. Davies, J. M. Jones, and C. A. Neilson. *Oil Gas J.*, 26.5.1938, **37** (2), 62.—A discussion is presented of an investigation that has been made of uniform methods of studying and combating corrosion in refineries. Following an outline of the most frequent causes of corrosion, recommendations are given of the points which a corrosion investigation should cover—viz., determination of cause of corrosion, amount of corrosive material, extent of corrosion and the selection and control of methods of combating corrosion.

The investigation procedure adopted in the case of two typical distillation operations and the corrosion prevention methods adopted are fully described. An appendix includes details of the methods used for the determination of (1) the halogen salt content of crude oil as sodium chloride, (2) the HCl and H_2S released during crude-oil distillation, (3) the SO_2 released from acid-treated distillates, (4) the iron content of distillates and (5) the pH value of condensates. C. L. G.

897. Filtration, Accuracy of Prediction of Plant Operations from Test Data. E. L. McMillen and H. A. Webber. *Industr. Engng. Chem.*, 1938, **30** (6), 708.—The constant-pressure filtration equation proposed by Ruth (*Ind. Eng. Chem.*, 1935, **27**, 708 and 806) is applicable to any type of sludge, and, in a differential form, allows a straight-line plot to be obtained from which the filter-cake and filter-cloth resistances can be evaluated.

The authors carried out a series of experimental filtrations on a small plate filter-press using calcium carbonate sludge containing 10–15% solids, at pressures between 5 and 60 lb. per sq. in. The data obtained were applied to two vacuum rotary filters, using sludges from 2 to 54% solids. The accuracy of prediction was good. P. D.

898. Vapour Rectification Gasoline Plant. H. H. Beeson. *Nat. Petrol. News*, 18.5.38, **30** (20), R. 241.—In the East Texas Oilfield some 25,000 wells have been connected up to one of a number of natural gasoline plants. All the oil is passed through centralized separators, whence the gas passes to the recovery plants and the stabilized crude back to the producer. A typical analysis of the gas delivered to the recovery plant is given as :—

	Mol.-%.
Methane	40·96
Ethane	15·97
Propane	22·29
*iso*Butane	4·01
N-Butane	10·05
*iso*Pentane	2·67
N-Pentane	1·96
Hexanes	1·29
Heptanes and heavier	0·80
	100·0 mol.-%.

The production of gasoline, butane, and propane amounts to about 540,000 brls. per month. The gasoline is of 26 lb. Reid V.P. The butane contains 10% propane, but facilities are available for the recovery of 70% of the available propane.

H. G.

Cracking.

899. Combination Cracking Economics. E. R. Smoley. *Nat. Petrol. News*, 4.5.38, **30** (18), R. 203.—In illustration of the manner in which the economics of a particular process or plant may be submitted to analysis, the process is carried out in relation to three typical plants : (*a*) two coil-cracking plant, (*b*) two-coil cracking and topping and (*c*) separate cracking and topping. Various factors, such as capital investment, volume of throughput, cost of crude and products, cost of services, chemicals and fuel, etc., are plotted against each other to yield information of assistance in the choice of the best plant or process for a particular set of constant conditions. H. G.

900. Treating Cracked Gasoline. S. C. Smith. *Oil Gas J.*, 7.4.38, **36** (37), 44.—The process described is the electrolytic regenerative method using sodium *ortho*plumbate as treating agent. The reactions between *ortho*plumbate and mercaptans may be represented :—

$$2RSH + NA_4PbO_4 = 2RS + Na_2PbO_3 + 2NaOH \quad (1)$$
$$2RSH + Na_2PbO_2 = (RS)_2Pb + 2NaOH \quad (2)$$
$$(RS)_2Pb + S = 2RS + PbS \quad (3)$$

The plant consists of a motor driving a 300-ampère direct-current generator, the current from which is led to a cell-box of suitable metal utilized as anode. Multiple cathode plates are encased in porous clay jars with soda, of approximately the same Bé gravity as the treating solution, used as catholyte. The analyte is the treating solution, originally sodium plumbite, but oxidized to *ortho*plumbate in the cell-box : $Na_2PbO_2 + 2NaOH = Na_4PbO_4 + H_2$(4). The *ortho*plumbate is pumped to a mixing coil consisting of six 4-in. Durion mixing nozzles, together with the raw caustic-washed gasoline, and the mixture passes to a settling-tank. Sweetened gasoline passes to storage, and the partly spent solution returned to the cell-box for regeneration to sodium *ortho*plumbate. It will be seen from equation (1) that the first two molecules of mercaptans are converted into disulphides by oxidation. The time required for this oxidation is appreciably less than when metaplumbate is used as treating agent. By regenerating after reduction to plumbite, reaction (4) takes place when the spent solution passes through the cell-box. The only material actually lost in the process is hydrogen evolved at the cathodes. Since the catholyte is soda solution, this is a

concentration, and is taken care of by addition of water to the cathode chambers once or twice per day. An anode slightly soluble in the analyte is preferable, as the clean surface permits use of a higher current density without forming molecular oxygen. The two major advantages claimed are simplicity and economy. Current consumptions for E. Texas and Smackover cracked gasolines were 0·024 and 0·071 kw. per brl., respectively. The plant described has a capacity of 600–800 brls. a day. When using a copper anode a cell efficiency of 82% was obtained, whereas iron gave an efficiency of only 25%. Since no sulphur is used in the process, there is no chance of corrosive gasoline, and the lead susceptibility is increased. R. A. E.

901. Patents on Cracking. Universal Oil Products Co. E.P. 484,368, 4.5.38. Increasing the anti-knock value of motor spirit by reforming it at 450–700° C., using as catalyst a solid granular siliceous substance comprising feldspars in which the alkali-earth metals have been partly or wholly replaced by other metals or zeolites in which the alkali metals have been similarly replaced.

N. V. Nieuwe Octrooi Mij. E.P. 484,527, 6.5.38. Cracking hydrocarbon oils at 900° F. with the aid of a heat carrier gas which is admixed with the vapour and condensing the gas mixture in another zone to separate the liquid products. The still gas is polymerized to produce high-octane fuel.

H. V. Atwell. U.S.P. 2,118,288, 24.5.38. Cracking of hydrocarbon oils to separate gasoline and then contacting the residual conversion products with unsaturated hydrocarbon gases at 750–1100° F. in the presence of a limited amount of free oxygen. The products are fractionated to produce gasoline and a higher-boiling fraction which is sent to the cracking zone for further conversion.

G. Egloff. U.S.P. 2,119,101, 31.5.38. Cracking of hydrocarbon oil to give a light and a heavy fraction and combining the heavier fraction with the unvaporized oil and hydrogenating the resultant mixture. The light fraction is hydrogenated independently at lower temperatures and higher pressures than the mixture and the heavy condensate recycled and cracked. W. S. E. C.

Polymerization.

902. Polymerization Unit Cuts Crude Requirements by 3–4%. A. L. Foster. *Nat. Petrol. News*, 1.6.38, **30** (22), R. 259.—In the plant described, the thermal polymerization process is applied to 22 million cu. ft. of waste refinery gas per day with a yield of 1850 brls. per day of 76–78 octane-number blending gasoline. This replaces a daily requirement of 3000–3500 brls. crude. Sulphur is removed from the gases, before polymerization, by the phenolate process. H. G.

903. Developments in the Use of Petroleum Derivatives. G. Egloff. *Petrol. Times*, 28.5.38, **1011** (39), 685, 4.6.38, **1012** (39), 735.—In the production of 95–100 octane-number gasoline *n*- and *iso*-butenes, from cracked gases, are catalytically polymerized to *iso*-octenes which have an octane number of 84 and a blending octane rating up to 155. *iso*-Octane is produced by hydrogenating *iso*butene, or *iso*butene can be polymerized to 2 : 2 : 4-trimethylpentene, which is then hydrogenated to 2 : 2 : 4-trimethylpentane of 100 octane number. Polymerization plants now in operation or under construction will have an aggregate annual output of 20,000,000 brls. Lubricants have been manufactured by the polymerization of propene, butenes, pentenes, etc., by means of aluminium chloride. These polymers are efficient as dopes for increasing the wear-resisting properties of certain lubricating oils. Many of the alcohols, glycols and ketones are produced on a commercial basis from petroleum derivatives. Some 10,000,000 gals. of ethyl alcohol are produced annually at a price competitive with that of alcohol produced by fermentation processes. Ethylene and its homologues are in successful use for accelerating the ripening of fruit and for shortening the growth season of fruit trees. Ethylene oxide has been used as a fumigant. Members of the same series are in use as anæsthetics, in which field they show advantages over the conventional media in the absence of undesirable after-

effects. Sulphuric acid is being produced by the oxidation of H_2S in such quantities that the industry may soon be self-supporting in this respect.

The article includes a discussion of the corrosion problem of the petroleum industry.
H. G.

904. Opportunities for Natural Gasoline. R. C. Alden. *Nat. Petrol. News*, 18.5.38, **30** (20), R. 247.—Natural gasoline has not been improved to the same extent as refinery gasoline, and the natural-gasoline industry is suffering in consequence. The article discusses the possibilities of the natural products and some of the ways in which improvements can be achieved. There is a relatively small demand for natural gasoline in the summer months, and therefore centralized co-operative storage during the summer for the winter demand is urged. *iso*Pentane has been shown to possess a high anti-knock rating and lead susceptibility. Large quantities of this body could be separated without greatly degrading the residual material. Polymerization of natural gas to suitable fuel hydrocarbons and the synthesis of intermediates for the chemical industry are promising avenues for future exploitation. It is suggested that at present natural gasoline suffers an unfair handicap in that the present methods for the determination of anti-knock value are not entirely suited to that material, and that more suitable methods should be developed. H. G.

905. Patents on Polymerization. Standard Oil Development Co. E.P. 484,170, 2.5.38. Polymerization of a mixture containing 20–40% of normal butenes and 10–15% of *iso*butenes using a solid catalyst at normal pressures and at 20–350° C. The normal and *iso*-olefins are passed over a second solid catalyst at 50–150° C.

I. G. Farbenindustrie A.G. E.P. 484,599, 9.5.38. Production of polymerized products by polymerizing a ketone of the general formulæ $R - CO - CH = CH_2$, where R is a naphthyl group or substituted phenyl group containing an alkyl, alkoxy- or acyloxy-group and halogen atom.

V. Ipatieff and B. B. Corson. U.S.P. 2,116,151, 3.5.38. Production of liquid polymers from ethylene at 500–700° F. and under a pressure of 300 lb./sq. in. using as catalyst a calcined mixture of phosphoric acid and a siliceous material.

J. C. Morrell. U.S.P. 2,116,157, 3.5.38. Production of normally liquid hydrocarbons by catalytic polymerization of a gas mixture under pressure containing more than two carbon atoms including four carbon-atom olefins and paraffins. The polymers are separated and the separated paraffins dehydrogenated to give four carbon-atom olefines which are supplied in liquid form to the polymerizing step.

G. W. Robinson and G. Roberts, jun. U.S.P. 2,118,822, 31.5.38.—Polymerization of cracked gases to produce motor spirit. W. S. E. C.

Hydrogenation.

906. Patents on Hydrogenation. H. E. Potts. E.P. 481,875, 15.3.38. Catalytic destructive hydrogenation of carbonaceous materials in the presence of NH_4Cl in which the halogens are removed by means of Ca compounds and the calcium halide separated by filtration or centrifuging. The oil boiling above 300° C. is subjected to further treatment with coal in the presence of alkali metal salts of acids of sulphur or phosphorus or the corresponding NH_4 salts, or carbonates of Na, K or NH_4, or NH_4OH and CO_2 under pressure.

H. E. Potts. E.P. 484,084, 27.4.38.—Catalytic destructive hydrogenation of middle oils in the presence of ammonia, nitrogen bases, phenols at 300–500° C. and under 50–500 atm. pressure for the production of aviation spirit.

H. E. Potts. E.P. 484,334, 4.5.38. Hydrogenation of the products obtained by extracting solid carbonaceous substances with a mixture of tetrahydronaphthalene and phenol and adding middle oil and/or heavy oil as diluent. The hydrogenation is carried out at 400–460° and >200 atm. pressure using as catalyst-tin oxalate and ammonium chloride.

Hercules Powder Co. E.P. 484,357, 4.5.38. Hydrogenation of an abietyl compound in the presence of an Al–Ni alloy which has been pretreated to increase its activity.

Universal Oil Products Co. E.P. 484,417, 5.5.38. Conversion of paraffin hydrocarbons into the corresponding olefines by dehydrogenation at 400–770° C. using as catalyst aluminium oxide and chromium sesquioxide.

G. W. Johnson. E.P. 484,525, 6.5.38. Production of unsaturated hydrocarbons by hydrogenation of gaseous hydrocarbons boiling below 300° C.

Society of Chemical Industry, Basle. E.P. 484,862, 11.5.38. Production of dehydrogenation products from heterocyclic bases using imidazoline.

Standard Oil Development Co. E.P. 485,178, 13.5.38. Catalysts for the dehydrogenation of hydrocarbons prepared in the form of pills and packed in an elongated vertical reaction zone composed of an oxide of a metal in group 6 of the periodic system, alumina, a small quantity of lubricant and a small amount of boric acid.

E. Dorrer. U.S.P. 2,116,061, 3.5.38. Crude aromatic hydrocarbons are mixed with hydrogen in the vapour-phase and heated to 400° C. and the resultant main product treated with hydrogen at 200–350° C. using a catalyst immune from poisoning by sulphur.

M. Pier, W. Kroenig and E. Donath. U.S.P. 2,118,940, 31.5.38. Destructive hydrogenation of carbonaceous substances at 250–700° C. and >20 atm. pressure in the presence of sulphur monochloride. W. S. E. C.

Chemistry and Physics of Petroleum.

907. Alkylation of Benzene with *cyclo*Paraffins in the Presence of Sulphuric Acid. V. N. Ipatieff, H. Pines and B. B. Corson. *J. Amer. chem. Soc.*, 1938, **60**, 577–578.—*cyclo*Propane was found to alkylate benzene in the presence of cold 96% sulphuric acid, to yield *n*-propylbenzene, part of the *cyclo*propane being found in the catalyst acid in the form of *n*-propyl sulphate. Similarly, methyl*cyclo*butane alkylated benzene to give *t*-amylbenzene, but *cyclo*pentane under the same conditions did not react. Of the three *cyclo*paraffins studied, *cyclo*propane was the most reactive. W. E. J. B.

908. Organic Reactions with Boron Fluoride. XIX. Condensation of *cyclo*Propane and Olefins with Acids. T. B. Dorris and F. J. Sowa. *J. Amer. chem. Soc.*, 1938, **60** (2), 358–359.—In an earlier paper a study was made of the condensation of propylene with acetic, benzoic and chloroacetic acids in the presence of boron fluoride.

The purpose of this investigation was to extend the olefin-acid condensation in order to determine the effect of various olefins and acids. Just as benzoic acid was found to undergo esterification without any nuclear substitution, so *p*-nitrobenzoic, *o*-chlorobenzoic, phenylacetic and furoic acids also underwent esterification when exposed to olefins and boron fluoride. *o*- and *p*-Aminobenzoic acids did not react. Propylene, butylenes and amylenes yielded *s*- or *t*-alkyl esters, together with an abundance of polymeric products. *cyclo*Propane yielded the *n*-propyl esters. W. E. J. B.

909. 2 : 2 : 3 : 4-Tetramethylhexane and 3 : 3 : 5-Trimethylheptane. N. L. Drake and L. H. Welsh. *J. Amer. chem. Soc.*, 1938, **60** (2), 488–489.—The above hydrocarbons have been prepared by the hydrogenation of the corresponding olefins. The latter were obtained by the action of sulphuric acid on methyl*iso*propylcarbinol.

The hydrocarbons were purified by percolation over silica gel. Constants for the respective hydrocarbons are: n_D^{25} 1·4202, 1·4208, d^{25} 0·7511, 0·7516, B.P. (763 mm.), ° C., 156·6, 159·2. W. E. J. B.

910. Application of the Grignard Reagent to a Study of Mineral Oils. R. G. Larsen. *Industr. Engng. Chem. Anal.*, 1938, **10**, (4), 195–198.—Apparatus and technique for the investigation of the interaction of methyl magnesium iodide and mineral oils are described and the significance of the reaction is discussed.

In the reaction with oxidized oils, the amount of methane evolved is a measure of acids, alcohols and water present; the amount of reagent consumed is an indication of, besides these compounds, peroxides, esters, aldehydes and ketones, and is therefore an indication of the total content of oxidized molecules.

It is found that a dry, unoxidized oil produces more methane than can be accounted for by extraneous contamination. The volume produced varies for different oils, decreasing as the degree of refining is increased, and a relationship between the amount of methane evolved by an oil and its subsequent rate of oxidation is found to exist. It is suggested that the correlation may be due to reaction with sulphur compounds, active hydrocarbons or deep-seated reactions catalysed by the Grignard reagent.

T. T. D.

911. Catalytic Combustion of Gases on Metals. W. Davies. *Engineering*, 27.5.38, **145**, 587.—A study is made of the heterogeneous catalytic oxidation of hydrogen, carbon monoxide, methane, acetylene and mixtures of these gases with each other in the presence of air. The method described involves a comparison of the heat loss from a thin wire of the catalytic metal when maintained at a given temperature in air and in the inflammable gas–air mixture. Except in the case of acetylene, the combustion of which is promoted by nickel, it was found that platinum is the only metal to promote appreciably the combustion of the gas–air mixtures examined. It was found that in the presence of platinum the oxidation of hydrogen is initiated very abruptly at 200° C.; similarly the carbon monoxide oxidation is initiated at 400° C. and the methane oxidation at 800° C. The rate of combustion of hydrogen and carbon monoxide increases up to 1200° C. and decreases as the temperature rises above this point, whereas the rate of combustion of methane increases continuously up to 1600° C. In the case of mixtures of hydrogen and methane the difference in the initiation temperatures for the two reactions leads to preferential action at temperatures below the initiation temperature of methane. The presence of acetylene raises the initial reaction temperature of the hydrogen to 600° C. J. W. H.

912. Preparation of Naphthene-Sulphonic Acids from Petroleum. S. v. Pilat and N. Turkiewicz. *Petrol Z.*, 23.2.38, **34** (8), 5.—This work is concerned with sulphonic acids derived from naphthene hydrocarbons, and not by-products from the acid refining of distillates. The direct action of H_2SO_4 or SO_3 on *cyclo*-paraffins is accompanied by oxidation, wherefore the authors employ the Strecker reaction as a means of introducing $-SO_3H$ groups.

Technical naphthenic acids were converted into methyl esters, which were then fractionated by distillation. The fractions were reduced to alcohols by means of Na and alcohol. Chlorides were then prepared by the action of PCl_5. On heating the chlorides with excess crystalline sodium sulphite in an autoclave for 2 hrs. at 200° C., sodium sulphonates were produced. A little alcohol was formed by hydrolysis, but olefine formation (by loss of HCl) was only slight. The Na sulphonates were extracted from the mass with alcohol, and the extract, after evaporation of alcohol, was treated with petroleum spirit to remove naphthenic alcohols. The residue was treated with Ba or Hg salts, which precipitated aliphatic sulphonates, leaving Ba or Hg naphthene-sulphonates in solution. In this way the C_{10}, C_{12}, and C_{14} acids ($C_nH_{2n}SO_3H$) were prepared in a pure state.

The products were strong acids, readily soluble in water, and yielding colourless, crystalline Na salts. The Ca, Ba and Hg salts were water-soluble. The Na salts considerably reduced the surface tension of water and promoted frothing.

P. G. H.

913. Drying Oils and Resins. T. F. Bradley. *Industr. Engng. Chem.*, 1938, **30** (6), 689.—A mathematical treatment of polymerization is given relating to the chemistry of drying oils. Observed molecular weight–iodine value relations of heat-thickened tung and linseed oils correspond most closely to those typical of a hexafunctional system, particularly in the case of tung oil. Anomalies are occasioned by intra-molecular additions, partial hydrolysis and other extraneous reactions, which phenomena have been studied by solvent extraction of stand oils. Colloidal aspects play a secondary part, but may eventually find complete correlation experimentally with the polymerization phenomena. H. C. R.

914. Phase Equilibria in Hydrocarbon Systems. Thermodynamic Properties of iso-Butane. B. H. Sage and W. N. Lacey. *Industr. Engng. Chem.*, 1938, **30** (6), 673.—Experimental determinations of vapour pressure, heat capacity, Joule–Thomson coefficients, and latent heat of vaporization were made in apparatus described in previous papers over the range 70–250° F. The data obtained, combined with reliable data from the literature, were used to calculate the changes in entropy, enthalpy and fugacity over the range of temperature and pressure. The experimental and the derived properties are presented in tabular and graphical form. P. D.

915. Tripotassium Phosphate for H_2S Removal. T. W. Rosebaugh. *Nat. Petrol. News*, 1.6.38, **30** (22), R. 280.—Solutions of 40–50% wt. K_3PO_4 and NaOH are used to remove H_2S from petroleum gases according to the equation $K_3PO_4 + H_2S = K_2HPO_4 + KHS$. H_2S is recovered by boiling the solution. The H_2S may then be converted into H_2SO_4, burned as fuel or used for the recovery of S. The process is simple, easy to control and cheap, since no reagent is lost except adventitiously. Liquids as well as gases may be treated. H. G.

Analysis and Testing.

916. Proximate Analysis of Gasoline. C. L. Thomas, H. S. Bloch and J. Hoekstra. *Industr. Engng. Chem. Anal.*, 1938, **10** (3), 153–156.—The authors describe and discuss a method for the routine analysis of relatively small (100–300 mls.) samples of gasoline.

The sample is fractionated in a still with an efficiency equivalent to 5–10 theoretical plates, into cuts of approximately uniform mol. wt.

The olefins in each fraction are determined by the bromide–bromate method, for, since the mol. wt. of the fraction is known, the percentage weight of olefin present can be calculated directly from the bromine number.

Total olefins and aromatics in each fraction are determined by a single extraction at 0° C. with fuming sulphuric acid (25% SO_3), the percentage volume being calculated directly from the contraction in the hydrocarbon layer. It is shown that under the conditions specified the whole of the olefinic and aromatic content is removed, leaving a residue of paraffins and naphthenes in a degree of purity sufficient for further analysis.

The authors have prepared refractive-index curves for mixtures of paraffins and naphthenes of the same mol. wt. from the figures given in the literature. By determining the refractive index of the residue from the sulphuric acid extraction, the molar percentage of naphthenes may be read off from the appropriate curve. The authors hold that, especially in the lower fractions, the error involved in the determination of naphthenes and paraffins by this method is not greater than the experimental errors inherent in the rest of the analysis. In the high-boiling naphthene fractions (10–11 carbon atoms) greater errors are probable, owing to complications arising from isomers of very different refractive index, but, as in most gasolines the amounts of these fractions are small, relatively large errors in the analysis of the actual fractions do not greatly affect the analysis of the entire gasoline.

The authors point out that, although the results should be expressed in consistent units, very little error is introduced by expressing them in the units in which they are determined: Olefines as percentage weight; aromatics as the difference between the percentage volume of aromatics and olefins, and the percentage weight of olefins; naphthenes and paraffins as moles per cent. of the residue from the sulphuric acid extraction, this residue being expressed in percentage volume.

The limit of precision of the method is about 5%, and it is claimed that, whilst it is not rigorously accurate, it is convenient, and has the advantage of requiring comparatively little material. T. T. D.

917. Determination of Inorganic Salts in Crude Oil. C. M. Blair, jun. *Industr. Engng. Chem. Anal.*, 1938, **10** (4), 207–209.—To 100 mls. of crude dissolved in 100 mls. of xylene are added 4 mls. of a 5% xylene solution of Destabilizer A, the mixture is shaken for 30 secs., 100 mls. of boiling water are added and the whole is shaken for a further 5 mins., after which it is allowed to stand. On separation, the aqueous layer is analysed in the conventional manner.

It is claimed that Destabilizer A (ammonium salts of isomeric sulphonic acids of high mol. wt., characterized by soluble calcium and magnesium salts) completely breaks down the very stable brine emulsion in the crude, so that one extraction is sufficient to remove at least 95% of the water and water-soluble material in the oil.

For routine determination of anions only, the following more rapid method is suggested.

25 mls. of crude and 2 mls. of a 2% xylene solution of Destabilizer B (a mixture obtained by the acylation of polyhydroxyglycerides) are poured into a 100-ml. A.S.T.M. centrifuge tube, which is then filled up to the 50-ml. mark with xylene and shaken for a few seconds. 50 mls. of boiling water are then added, the tube is shaken for 3 mins. and centrifuged for 1 min. The tube is then emptied into a separating funnel and the aqueous layer analysed in the conventional manner. T. T. D.

918. Determination of Sulphur in Oil. R. T. Sheen and H. L. Kahler. *Industr. Engng. Chem. Anal.*, 1938, **10** (4), 206–207.—The standard method of oxidation of sulphur in oil by ignition in a bomb is followed by complete oxidation with bromine, concentration of sample to a definite volume (100 mls.) and direct titration of an aliquot part with standard barium chloride solution, using tetrahydroquinone as internal indicator.

With the indicator described (the di-sodium salt of tetrahydroquinone dispersed in a solid organic medium) a sharp E.P. is obtained, and the accuracy is well within the limits of tolerance prescribed by the A.S.T.M. for the gravimetric method.

T. T. D.

919. High-Vacuum Gas-Analysis Apparatus. E. C. Ward. *Industr. Engng. Chem. Anal.*, 1938, **10** (3), 169–171.—A high-vacuum method for the analysis of small (150 mls.) gaseous hydrocarbon samples is described in which fractionation is effected at pressures of less than 1 mm. of mercury by means of a series of simultaneous partial distillations and condensations through a series of tubes maintained at appropriate temperatures. Supplementary tests, such as oxygen determinations, bromination of unsaturated compounds, slow combustions, etc., may be made without removing the sample from the apparatus, and it is claimed that traces of heavy material at the ends of distillation are determined with unusual accuracy.

The accuracy attainable is of the order of 0·1% of the total sample for methane, and of less than 0·1% for ethane, propane and butane. In the case of dry gases the pentane and heavier fraction checks to 0·02%, but in heavy gases containing more of these fractions the normal accuracy is 0·1%.

The high-vacuum fractionation train is used for the separation of hydrocarbons only. Carbon dioxide is removed first, and permanent gases separate with the methane and are analysed by supplementary tests. The apparatus is adapted, by including the appropriate reagents, to the analysis of hydrogen, carbon monoxide, nitrogen, helium, carbon dioxide, hydrogen sulphide, methane, ethylene, ethane, propylene, propane, total butylenes, butanes, and pentane and heavier residues, without any necessity of transferring sample from one apparatus to another.

As this apparatus does not work well with liquid samples, a fractionating column assembly, similar to the conventional gas-analysis apparatus, is incorporated in the system for the analysis of liquids, and it is possible to transfer fractions from this column to the high-vacuum apparatus for further analysis. T. T. D.

920. Determination of Oil and Water by the Retort Method. S. I. Yuster and J. S. Levine. *Oil Wkly*, 23.5.38, **89** (11), 22.—The retort method of determining the fluid saturation of oil sands is one of the commonest used, but certain inherent errors in this method have not been investigated to any great extent. The authors have studied some of these errors, and they discuss them in this article.

The deposition of residual carbon on the sand is a source of error, since it means that a certain amount of oil has been decomposed, and if it is supposed that each atom of carbon was originally a CH_2 group, then the weight of carbon multiplied by the ratio of the weight of a CH_2 group to carbon a still greater error is shown.

Another conclusion is that the correction for oil lost because of cracking is a function of the permeability. This becomes important only in sands of permeability of less than one millidarcy, and possibly in the higher permeability range.

The extent of cracking is a function of the total surface with which the oil is in contact, and also upon the time in which the oil is in contact with that surface.

The method is rapid and rugged, but there are possible errors which do not allow an accurate investigation of the sample to be made. It is, however, accurate enough, in general, for correlation and production work in the field. L. V. W. C.

921. Melting-Point Studies of Binary and Ternary Mixtures of Commercial Waxes. J. R. Koch, G. J. Hable and L. Wrangell. *Industr. Engng. Chem. Anal.*, 1938, **10** (3), 166–168.—The melting points of various commercial waxes and binary and ternary mixtures of them are determined by a standard technique. Curves giving the composition of mixtures of identical melting point are plotted for the trinary systems on triangular paper, and it is shown that they are all straight lines within the limits of experimental error, proving that no compound formation takes place.

The waxes investigated are paraffin wax (m. pt. 55·5° C.), carnauba (m. pt. 82·5° C.), beeswax (m. pt. 61·5° C.), candellila (m. pt. 69·1° C.), Chinese insect (m. pt. 82·5° C.), ozokerite (m. pt. 67·8° C.), montan (m. pt. 73·2° C.). T. T. D.

922. Storage Stability of Power Alcohol and Alcohol Fuels. K. R. Dietrich and W. Lohrengel. *Oel u. Kohle*, 1938, **14**, 419–422.—This investigation was undertaken to determine the stability to storage of absolute ethyl alcohol as available for engine fuel, alone, admixed with methanol and blended with benzine with and without methanol.

An apparatus was constructed for storing these fuels in contact with air, over long periods, care being taken to exclude moisture. Samples were drawn and tested over a period of 12 months.

Five samples each of alcohol, methanol and benzine were tested separately and in blends, 65 fuels in all being examined. The alcohol fuel consisted of 8 parts of absolute alcohol and 2 parts of methanol, and had to conform to an official specification.

Gum and colour determinations were made on all samples, the former being carried out by an evaporation method in a glass dish assisted by an air blast.

The results were compared with those obtained in a bomb test in which 200 c.c. fuel were heated for 4 hrs. at 100° C. under a pressure of 7 atms. of O_2. Gum content before and after, fall in pressure and induction period were measured.

None of the fuels showed gum contents of more than 10 mgm./100 c.c. after 1 year's storage (highest gum 3·7 mgm./100 c.c.). However, the bomb figures were considerably higher, and in general showed absolutely no correlation with the storage results.

It was concluded that the bomb results were of little use, since, although a fuel passing this test would undoubtedly be satisfactory on storage, one failing to pass might also be satisfactory under these conditions.

Thus, of the 65 fuels tested, all were stable to storage, although more than 50% failed in the bomb test.

It was concluded that absolute ethyl alcohol alone or blended with methanol or benzine possessed a satisfactory storage stability. D. L. S.

923. Patents on Analysis. Eastman Kodak Co. E.P. 485,549, 18.5.38. Distillation of natural glycerides.

Eastman Kodak Co., E.P. 485,614, 18.5.38. Molecular distillation of linseed and similar oils.

H. R. Swanson and J. S. Wallis. U.S.P. 2,115,793, 3.5.38. Fractional distillation apparatus for hydrocarbon oils.

E. G. Ragatz. U.S.P. 2,116,933, 10.5.38. Fractionating column for hydrocarbon oils. W. S. E. C.

Motor Fuels.

924. Economic Aspects of the Pawhuska Road Tests. W. W. Scheumann. *Oil Gas J.*, 28.4.38, **36** (50), 71.—The economic meaning of the results of this investigation reported by Legatski and Couch (*a*) to the refiner, (*b*) to the motoring public, is discussed. In

considering the maximum permissible vapour-pressure data it must be remembered that these values are for extreme conditions, and that under normal driving conditions a fuel of somewhat higher vapour pressure can be handled, also that results are based on fuel in the automobile tank, and are therefore not indicative of the vapour pressure permitted of fuels at service station or refinery. Tabulated results show (*a*) the variations in maximum permissible Reid vapour pressure for different cars tested at temperatures of 80–100° F., (*b*) the differences between the fuels of maximum vapour pressure which can be handled by the two cars showing the greatest divergence in this respect, at temperatures of 60–110° F., in terms of difference in butane content. (3) Based on daily maximum temperature data, and on gasoline consumption data, there is a possible increased butane utilization of 6½ million brls. butane per annum, assuming (*a*) that the refiner is now building fuels for the poorest cars from the standpoint of vapour lock, and (*b*) that the worst cars were improved to equal the best in this respect. This possible increased utilization is much less than the amount of butane available for, but unused in, motor fuel. The butane is therefore probably now valued at the price of fuel gas, say 10 cents per 1000 cu. ft., as compared with gasoline at, say, 5½ cents per gal., and if allowance is also made for decreased lead requirement of finished gasoline, the increased value of this amount of butane if used as motor fuel would be about $18 million.

Fuel losses from the fuel tank and from the carburettor were measured on only two cars, but those tests showed a fairly close relationship between vapour pressure of the fuel in the tank, the carburettor bowl temperature and the volumetric loss. Calculations for other cars thus show possible losses of 3–7% operating at 90–100° F. on fuel of 9 lb. vapour pressure. The annual overall fuel loss from this source is estimated conservatively at 1·96%, equivalent to a loss of 0·54 octane number. This octane loss, calculated on an ethyl-fluid basis on 70% of annual motor-fuel requirements, means that over $2 million spent on improving anti-knock are lost before the fuel gets to the engine. The cost of actual fuel loss from tank and carburettor comes directly out of the consumer's pocket. Using data available for vapour pressure of fuels marketed at various atmospheric temperatures, coupled with the results of the car tests, it is conservatively estimated that the fuel loss from these sources is 1·96%, and that the cost to the public is at least $65 million. R. A. E.

925. Fuel Vapour Losses. W. W. Scheumann. *Nat. Petrol. News*, 4.5.38, **30** (18), R. 217.—Some of the results of the Pawhuska Road Tests are discussed. In these tests seven standard 1937 cars were operated under road conditions to determine (*a*) the maximum permissible vapour pressure for the gasoline for each car, (*b*) the extent to which fuel was lost by evaporation from the fuel tank and from the carburettor. It was found that the cars varied considerably in respect of (*a*). On the assumption that the fuel must be blended with the demands of the poorest car in view, a potential market for 62,500,000 gals. of butane is available by improving fuel systems to the standard of the best car tested. Losses by evaporation were shown to amount to as much as 7%, the probable yearly average being about 2%. These losses represent a degradation in octane number of up to 2 and an aggregate annual loss by the consumer of $65 million. H. G.

926. Comparison of Methods of Testing Fuels for I.C. Engines. Kessler. *Oel u. Kohle*, 1.5.38, (17), 341.—Octane ratings of 16 fuels were measured (*a*) in various motors (C.F.R., I.G. Vario, and Olex) and (*b*) by the laboratory methods of Heinze–Marder (density) and of Jentzsch (ignition). The object of the work was to check the agreement between the methods, since in Germany it is felt that a test should be available which is independent of the C.F.R. Motor.

The I.G. motor was found to meet the requirements, its ratings being within 4% of those determined in the C.F.R. motor. Ratings derived from laboratory tests differed considerably from those given by motor tests. The density method gave consistently lower results, whilst the ignition values could not be correlated satisfactorily with C.F.R. values.

Comparison was similarly made between cetene values of diesel fuels measured in different motors (DVL single cylinder, C.F.R., I.G., Heeres and Olex) and by the two laboratory tests cited above. The results did not enable any one method or apparatus to be recommended as pre-eminently suitable for sole adoption. P. G. H.

927. Patents on Motor Fuel. Ruhrchemie A.G. E.P. 484,962, 12.5.38. Method of regenerating catalysts for benzine synthesis.

G. W. Johnson. E.P. 485,461, 19.5.38. Manufacture of pulverent motor fuels for dust-fuel motors by treating pulverulent solid extracts obtained from coals with oxides of N_2 or HNO_3.

J. C. Morrell. U.S.P. 2,115,781, 3.5.38. Treatment of stored cracked gasoline with a ferrous salt.

O. H. Dawson. U.S.P. 2,115,843, 3.5.38. Production of sulphonic acids from SO_2 extract of light mineral oil distillates which has been treated with alkali to remove naphthenic acids and subsequently acid-treated, the first batch of sludge being discarded.

G. J. Malherbe. U.S.P. 2,116,208, 3.5.38. Acid refining of cracked distillates.

F. E. Frey and H. J. Hepp. U.S.P., 2,116,723, 10.5.38. Production of aliphatic hydrocarbons as motor fuel by separating the *iso*butane from normally gaseous hydrocarbons and mixing it with a recycle stock (containing 50% of butane and a minor proportion of 3 and 4 C-atom hydrocarbons). The mixture is subjected to thermal conversion at 752°–1292° F. and under a pressure of 500 lb./sq. in.

J. W. Throckmorton. U.S.P. 2,117,464, 17.5.38. Conversion of C_2, C_3 and C_4 hydrocarbon gases to liquid.

H. E. Drennan. U.S.P. 2,117,548, 17.5.38. Process of extracting and recovering volatile hydrocarbons from hydrocarbon gases. W. S. E. C.

Lubricants and Lubrication.

928. Ageing of Paraffinic and Naphthenic Mineral Oils. E. Haus. *Oel u. Kohle*, 15.4.38 (15), 299; 22.4.38 (16), 321.—Closely cut oils, paraffinic and naphthenic in character, respectively, and containing no bright stock, were oxidized at 172° C., 200° C. and 250° C. for different periods. The asphaltic and resinous products of oxidation were isolated and studied. In all cases asphalt increased continuously, and more rapidly in paraffinic than in naphthenic oils, in spite of the fact that the former showed an induction period. This difference between the two types of oil was the more pronounced at the lower temperatures of test. In both types resin formation occurred rapidly at first, and then assumed a more or less steady value at the lower temperatures; at the higher temperatures resins decreased after reaching a maximum as oxidation proceeded.

The resins could be fractionated, and the elementary composition of the fractions suggested that resins formed by oxidation were transitional between oil and asphalt.

The Waterman ring-analysis was applied to the oils and their ageing products at successive stages of oxidation. It was found that with increasing temperature or time the oils tended to become more naphthenic in character.

The author considers that the oils initially contained a certain amount of dissolved O_2 which was in an exceptionally reactive condition, thus accounting for the initially high rate of resin formation at the beginning of oxidation.

Practical details of all methods used in the work are given at the end of the first paper. The influence of resinous oxidation products on ring-sticking is discussed. The view is held that asphalt is first deposited on the rings, etc., and then adsorbs to itself adhesive resins, the concentration of which may become high locally. A machine of the Schopper type was used to measure adhesivity of resins formed in the two oils. Resins from the naphthenic oil were more adhesive than those of paraffinic origin; this distinction held even when asphalt was also present in the resins. P. G. H.

929. Lubrication of Automobile Engines (Otto). K. O. Müller. *Oel u. Kohle*, 8.5.38 (18), 365.—Fourteen oils, differing in source and methods of refining, were tested both in a test-engine and in road vehicles. The object of the work was to find specification tests which would bear some relation to the practical requirements of lubricating oils.

An introductory section discusses the value of interfacial tension determinations

(Seelich) in judging lubricity, and proposes an actual estimation of polar material by adsorption in active earth. Full details of the technique are given (p. 373).

A volatility test, described elsewhere by Noack, is proposed as a laboratory ageing test which was found to reproduce the condition of the oil after 50 hrs. use in the testing engine. This test yields no asphaltic material, the presence of which in normal used oils is attributed to unburnt fuel.

Carbon residue, viscosity at 50° C., and asphalt and resins (earth adsorption) of the oils after (*a*) volatility test and (*b*) use in testing engine for 50 hrs. showed satisfactory agreement between (*a*) and (*b*).

Oil consumption was found to be higher and volatility less in engines running on gaseous fuel than in those using liquid fuel. This result suggested that unburnt liquid fuel itself acted as a seal between piston and cylinder wall, thus reducing oil consumption.

With respect to startability, viscosity at low temperatures is of more significance than pour tests.

Actual measurements of viscosity by Schwaiger's technique (*Oel u. Kohle*, 1937, **13**, 715) are preferred to extrapolated values for viscosity at low temperatures. It was found that the maximum oil viscosity at which a number of engines could be started was about 1500° E.

It is recommended that viscosity requirements be specified as maximum and minimum values permissible at 100° C., taken in conjunction with viscosity pole-height. P. G. H.

930. Ageing of Diesel Lubricating Oils in Use. R. Heinze and E. Widdecke. *Oel u. Kohle*, 1938, **14**, 413–419.—Diesel lubricating oils are subjected to the influence of the following factors in use.

(1) Engine conditions.
(2) Working conditions—*e.g.*, load, speed, etc.
(3) Type of fuel and lubricating oil used.

This paper deals particularly with (3), which is sub-divided into the behaviour of the lubricating oil in the engine (3*a*), under the influence of ageing processes (3*b*), with reference to its volatility at high temperature.

Experiments were carried out with six oils of good commercial reputation, and in thirteen engines, some stationary and some in motor vehicles. The conclusion reached with regard to (3*a*) was that, apart from contamination with fuel products, the oil was scarcely altered. Thus removal of the sludge from the used oil resulted in an oil with practically the same properties as the original lubricant.

It is recommended that a good filter should be used in the lubrication system, as this makes for economy in running.

The volatility of the oils (3*b*) was measured by the evaporative distillation method of Verver and Saal (*Proc. World Pet. Congress*, 1933, Proc. II, 402) at a temperature of 320° C. Curves were obtained, and from these a volatility number was deduced.

Excellent correlation was found to exist between the Pole heights, volatility numbers and the undistillable residues of the oils examined.

It was established that oils giving good service can vary considerably as regards their volatility and Bright Stock content.

It was concluded that a good selection of satisfactory diesel lubricating oils existed, and that no preference could be established for any particular type. D. L. S.

931. Chemical and Physical Constants of Two Lubricating-oil Fractions as Obtained by Fischer Tropsch Synthesis. D. J. W. Kreulen. *Chem. Wkbld*, **35** (22), 410–411.—The character of these oils differs from that of the common petroleum hydrocarbons in consequence of a very considerable branching of the aliphatic hydrocarbon chains. Roughly 50% of the C atoms occurring in paraffin chains are branched.

B. M. H. T.

932. Chemical Treating of Surfaces. New Principle in Lubrication. A. L. Foster. *Nat. Petrol. News*, 29.6.38, **30** (26), 25.—It is claimed that much of the wear occurring under conditions of high pressure is due to selective attrition and subsequent scoring by the detritus. According to the new process, wearing surfaces, such as cylinder

walls or bearing surfaces, are treated with a solution of chemicals of undisclosed composition which selectively dissolves ferrite and other bodies which are stated to be the constituents forming the detritus. It is claimed that the process, which has been put to commercial use, produces a surface with a bearing capacity six times that of an untreated surface when tested with a straight mineral lubricating oil. "Running-in" times are stated to be reduced considerably. H. G.

933. Aluminium Stearate Greases. F. J. Licata. *Industr. Engng. Chem.*, 1938, **30** (5), 550.—The general characteristics and suitability of aluminium stearate greases are outlined and results given of an investigation into their mode of manufacture. The grease-maker can modify the properties of such greases by control over the viscosity and type of compounding oil, rate of cooling, time of compounding and moisture content and lastly the use of fluxes. H. C. R.

934. Properties which Affect Lubricating Oil Performance. H. M. Rugg. *Nat. Petrol. News*, 4.5.38, **30** (18), R. 224.—Assessing the efficiency of a lubricant in terms of ease of starting, consumption and maintenance costs, the author concludes that viscosity and volatility are the most important characteristics in a lubricating oil. Comparing two oils of viscosity at 100° F. 43 and 63 and V.I. 13, and 100, the consumption in 48 hrs. was 22 and 10 quarts, respectively. Similarly interesting figures are given for the effect of volatility on consumption and the incidence of ring-sticking as a criterion of wear. It is concluded that there is no clear relationship between Conradson carbon residue and carbon formation on the piston-head. H. G.

935. Patents on Lubricating Oil. Burmah Oil Co. and R. E. Downer. E.P. 484,207, 2.5.38. Method and apparatus for the separation of paraffin waxes or oil-wax mixtures.

F. P. Bowden. E.P. 484,579, 5.5.38. Production of lubricating oils of low coefficient of friction and low surface wear by blending 1% of dibenzylidene, or diphenylbenzene or 2% of triphenylcarbinol with methyl*cyclo*hexanol oxalate or dimethyl*cyclo*hexanol adipate with known lubricating oils.

N. V. De Bataafsche Petroleum Mij. E.P. 484,964, 12.5.38. Production of polymerized products suitable for lubrication by polymerizing at 70–100° C. a mixture of an ester of an unsaturated aliphatic acid and an aliphatic saturated or unsaturated monohydric or dihydric alcohol not containing a vinyl group with a non-drying fatty oil using BF_3 as catalyst.

Standard Oil Development Co. and C. J. Arnold. E.P. 485,105, 13.5.38. Production of voltolized products from mineral oils by subjecting to the action of a silent electric discharge, a concentrate in admixture with an unsaturated glyceryl ester oil from the extraction of oil with phenol. Sulphur is dissolved in the concentrate before the action of the discharge.

E. G. M. R. Lagé. E.P.485,123, 16.5.38. Transformation of fatty and oleaginous vegetable and animal matter into a product similar to mineral oil by distillation at 250–600° C. in the presence of anhydrous alkaline salts formed with weak acids or amphoteric oxides.

A. P. Lowes, D. E. White and I.C.I., Ltd. E.P. 485,165, 11.5.38. Production of lubricating oil by chlorinating aliphatic hydrocarbons of high mol. wt., with benzene or toluene in the presence of aluminium chloride. The upper layer is separated by filtration through a solid reagent and then treated with conc. NH_4OH.

G. W. Johnson. E.P. 485,478, 20.5.38. Production of lubricating oils by treating paraffin hydrocarbons boiling between 170 and 250° C. obtained by conversion of carbon oxides, especially CO with hydrogen—with silent electric discharges until the products obtained have a viscosity of 20–100° Engler at 100° C.

E. R. Brownscombe. U.S.P. 2,115,704, 3.5.38. Solvent extraction of hydrocarbon oil using nitrobenzene containing maleic anhydride.

P. K. Frolich. U.S.P. 2,115,846, 3.5.38. Production of hard asphalt, wax of high melting point, and a highly viscous oil from pitch bottoms derived from a Talung Akar crude by means of propane.

R. P. Dunmire. U.S.P. 2,116,344, 3.5.38. Apparatus for purifying oil.

M. R. Fenske. U.S.P. 2,116,428, 3.5.38. Process and apparatus for solvent extraction.

W. B. McCluer. U.S.P. 2,116,442, 3.5.38. Distillation test for lubricating oils.

P. L. Cramer. U.S.P. 2,117,022, 10.5.38. Production of higher-boiling oils from olefines of lower boiling points, by preparing a mixture of hydrocarbons and solvent, adding a compound of lead or mercury and heating the mixture to decompose the metal compound.

R. Bulkley. U.S.P. 2,117,602, 17.5.38. Lubricating oils are rendered stable to oxidation by adding 5% of the material obtained by extracting solvent tar separated from a lubricating-oil fraction with acetone at 70–80° F. and acid-treating the extracted material.

J. Moos and H. Ramser. U.S.P. 2,118,766, 24.5.38. Dewaxing hydrocarbon oil using toluol and ethyl sulphonyl chloride.

E. Terres, E. Saegebarth and J. Moos. U.S.P. 2,118,772, 24.5.38. Treatment of hydrocarbon oils with chromyl chloride.

M. Blumer and L. Salzmann. U.S.P. 2,118,805, 31.5.38. Refining white oils with sulphuric acid.

E. W. Carlson. U.S.P. 2,119,097, 31.5.38. Production of coloured oil-soluble products by heat treatment of low-boiling cracked hydrocarbons.

J. C. Showalter. U.S.P. 2,119,120, 31.5.38. Prevention of formation of wax haze in lubricating oils by adding to the raw oil prior to acid-treating 0·1–3% of the acid sludge obtained in the acid-treatment of a residual lubricating oil fraction derived from a paraffin base crude.

O. E. Roberts. U.S.P. 2,119,403, 31.5.38. Stabilizing of lubricating oils by subjecting the lubricating oil distillate to limited oxidation with ammonium nitrate and reacting the distillate with an ammonium halide in a highly-dispersed state above 225° C. and within the boiling range of lubricants. W. S. E. C.

Asphalt and Bitumen.

936. Asphalt Recovery Tests and their Value as a Criterion of Service Behaviour. V. B. Steinbaugh and J. D. Brown. *Proc. Assoc. Asph. Pav. Technol.*, 1937, **9**, 138–164.—Investigation of the causes of cracking of bituminous pavements indicated that the use of asphalt cement subject to rapid weathering might be an important factor, and since doubt exists as to whether the changes occurring in the bitumen in the oven-heating test are similar to the changes which occur during mixing and laying a road surface, penetration and ductility tests were made on bitumen recovered by the Abson method from samples of satisfactory and cracked pavements. The average penetration of the bitumen from the latter was found to be appreciably lower, and the ductility less than one third of that of satisfactory pavements, and limits for decrease in penetration and ductility of bitumen recovered from paving mixtures were included in specifications. Subsequently an investigation was made of the Bussow method of recovery of bitumen in comparison with the Abson method and a combination of these two methods; the essential difference between the Abson and Bussow methods is that the bitumen is heated to a final temperature of 163° C. and carbon dioxide at the rate of 875 ml. per minute is bubbled through the bitumen in the former method, whereas a final temperature of 300° C. without carbon dioxide is used in the Bussow method. The combined method consisted of further heating the Abson residue to 300° C. without carbon dioxide. The three methods generally gave penetrations reasonably close to the original, but the Abson method in most cases gave lower ductilities, whilst the Bussow and combined methods gave higher ductilities than the original. It is suggested that the low ductility may be due to

removal of volatile constituents by carbon dioxide in the Abson method, and that the high temperature in the other two methods is responsible for the increase in ductility. Exposure of bitumen solutions to daylight prior to recovery did not affect results, but whereas the Abson residues showed progressively lower results with time, the Bussow residues were quite uniform up to 96 hrs., after recovery from an initial drop during the first day; this is attributed to failure of the oil–resin–asphaltene system to return to the original state in the Abson residues. The effect of incomplete removal of dust was examined by preparation of mixtures containing various amounts of dust of known grading, and an approximate formula for dust correction was derived, but it is pointed out that results are affected by particle size of the dust, and since the latter is unknown in practice, it is essential to remove the dust as completely as possible. Use of a super-centrifuge permitted recovery of bitumen having ash contents of 0·2–0·5%, and this is considered practically complete removal of dust. No indication of any change of the bitumen itself due to the use of the centrifuge was observed. In an attempt to discover a convenient oxidation test for bitumen, materials obtained by blowing Mexican bitumen at 215° C. with 875 ml. of air per minute in the Abson apparatus and residues obtained in the A.S.T.M. test for residues of specified penetration were found to show the same penetration–ductility relationship as residues recovered from field mixtures of the same asphaltic material. Results to date indicate that if an asphalt has a ductility of 40 cm. or more after 2 hrs. blowing, it will comply with the specification requirement of 40 cm. minimum ductility after recovery from the pavement. A. O.

937. Microscopic Reactions in Translucent Asphaltic Films. J. R. Benson. *Proc. Assoc. Asph. Pav. Technols.*, 1937, **9**, 102–132.—The paper describes an investigation of the behaviour of thin films of asphaltic material exposed to natural and artificial weathering conditions. The films, approximately 0·001 in. thick, were prepared by application of the materials to microscope slides by means of a gauge, and were then exposed to mild ultra-violet–infra-red radiations at 140–170° F.; to cold quartz—140° F.; to natural weathering; to carbon dioxide and oxygen at 325° F. and to air at 140° F. and 325° F. in the absence of light, after which the appearance was examined under the microscope, the films being classified as clear, coagulated, flocculated, waxy bodies, checked or hardened. Coagulation, which is considered the most interesting phenomenon, is defined as the curdling or drawing together into nodular or stringy form of a part or the whole of the film, and is believed to be caused by separation of the material into two constituents. The presence of wax was determined by observation of the optical activity of the bodies under polarized light, disappearance when heated and appearance in material previously free from bodies when addition of bodies from another material was made. Hardening is detected by noting whether the film under the microscope chips or cracks when touched with a needle; the rate of hardening may be determined at 140° F. Flocculation consists of the presence of brownish-red or black, round or oval-shaped bodies in the material checking is recognized by the formation of cracks which are believed to be caused by shrinkage of the film. A very large number of materials were examined, and results are tabulated and discussed, and photomicrographs of typical reactions are shown. A. O.

938. Flow in Asphalts. R. N. Traxler and L. R. Moffat. *Industr. Engng Chem. Anal.*, 1938, **10** (4), 188–191.—Typical data obtained by applying the method of successive penetrations to viscous and non-viscous asphalts are reported and the merits of the test as a rheological method for the evaluation of flow characteristics are critically examined. Three types of rheological diagram (rates of shear against shearing stress) are obtained: (1) an occasional asphalt known to be an essentially viscous liquid gives a straight line through the origin; (2) most asphalts known to be essentially viscous liquids give straight lines, which on extrapolation indicate negative yield values; (3) asphalts known to be non-Newtonian liquids give lines which on extrapolation cut the shearing stress axis, or else curves concave to the shearing stress axis. Changes in technique affect the diagrams obtained only in the case of non-Newtonian liquids.

Errors are introduced by the assumptions in the theoretical derivation, of laminar

flow during penetration, and that the whole of the penetrated length of the needle is wetted by the liquid, both of which are shown to be unjustified by observations on a transparent viscous resin. These discrepancies bear on the fact that diagrams are obtained with negative yield values, which shows that the method is rheologically unsound; but from the practical point of view it has value, especially in the investigation of air-blown asphalts over a range of rates of shear not easily studied in the absolute viscometers now available. T. T. D.

939. Exudation Test for "Bleeding" in Bituminous Roofing. G. L. Oliensis. *Industr. Engng. Chem. Anal.*, 1938, **10** (4). 199–201.—In the manufacture of roofing, a felted sheet is saturated with a hot, relatively soft, bituminous saturant, the excess removed, and a relatively hard blown asphalt coating is applied to both surfaces of the sheet. If the two asphalts are "incompatible," "bleeding" develops on storage and in actual use. This consists in the formation, on the surface of the roofing, of dull black spots, which grow, and may eventually become glossy black in colour and oily in consistency.

There is evidence that, if two "incompatible" asphalts are placed in contact at room temperatures, a very thin film of bitumen, of softer consistency than either, forms at the interface, where it remains permanently unless it migrates outwards, owing to capillarity, along a pin-hole in the upper layer, to form a black spot on the surface.

The exudation test, developed by the author, consists in applying a drop of the saturant to the talc-dusted surface of the coating, maintaining the latter at 110° F. for 72 hrs., and measuring the width of the black ring that forms round the periphery of the spot. It is maintained that no visible bleeding will occur in roofings made with a saturant and coating that develop a ring less than 0·5 mm. wide in the exudation test carried out at 110° F. with the author's standardized technique. T. T. D.

940. Use of Asphalt in River and Harbour Construction. W. F. Tomkins. *Proc. XI National Asphalt Conference U.S.A.*, Dec. 1937, 79.—A description is given of recent applications of asphaltic products for the production of river and levee banks from current and wave action, and in the construction of jetties. For the last-mentioned purpose the use of asphalt is still in the development stage, but promising results have been obtained in the following constructions: (1) An existent jetty at Galveston was capped in 1935 to prevent the infiltration of sand into the jettied channel and to increase the life of the jetty structure. A soft-flowing mix was poured into the cap-rocks and compacted by vibration, followed by a stiffer mix to complete the cap without forms above water, also compacted by vibration. Since 1935 some cracking has taken place, but the structure as a whole is intact. It has been the most successful method tried so far for preventing sand infiltration, although for jetty-strengthening it has not been so successful as was hoped. (2) Asphalt foundation-mats were sunk under a short experimental section of the jetty at Galveston in 1936, and have proved successful in preventing undermining. Similar but larger mats are being successfully used as protection in Panama City, and trials are being carried out with mattress protection of the shore end of the jetty from wave-action. (3) At Panama City an entire jetty is being rebuilt with asphalt mix. Mats 24 × 58 ft. are first sunk under the toe to form a continuous protection, and on the inner edge of the mattresses are lowered into place precast triangular prisms of various sizes, the space between them being filled with asphalt mix consolidated under water by vibration. When the mix is brought to the level of the top of the prisms, other rows of the latter are built up and the space between them is filled as before until the jetty is brought to the right height. It is hoped that the absence of expansion joints or other openings will enable it to withstand wave action and prevent the infiltration of sand. Although the work has so far not come fully up to expectations, it is too early to report on the success of the experiment and, in any case, a promising field of development has been opened, whilst the practical difficulties encountered will probably be overcome.

For the protection of river-banks the asphalt-mattress scheme applied to the lower Mississippi has now been fully developed.

For levee paving, the stretches below New Orleans, which are subjected to excessive wave-washing and wind-action, are coated with a 2-in. layer of asphalt mix. Where there is no freezing and thawing problem, protection of the lower river is adequate,

but owing to the softness of some uncompacted levees and to other troubles (which have now been overcome), cracking has taken place. Some of the paving laid in 1936 is still, however, free from cracks, so that this method should be of value under severer climatic conditions. The growth of vegetation through the asphalt pavement is prevented by the distribution of 1 lb. of salt per sq. ft. on the levee prior to paving. In general, it has been shown that a properly designed and compacted asphalt mix does not deteriorate under water. At the water level during hot weather, superficial cracking only is likely to occur, owing to the sudden cooling by waves on the hot asphalt pavement, but above and below the line no trouble is experienced.

C. L. G.

941. Practice and Experiments Utilizing Asphalt in Water Control and Erosion Prevention. J. E. Buchanan. *Proc. XI National Asphalt Conference, U.S.A.*, Dec., 1937, 89.—A summary is presented of existing constructional and experimental projects in the West covering the use of asphalt in water control and erosion-prevention works of the following types :

Reservoirs.—Asphalt is being used as a protective lining to earth reservoirs to eliminate percolation losses, to prevent wave erosion and to facilitate cleaning.

Details are given of the treatment applied to three reservoirs in Los Angeles, Riverside and Iron Mountain (California), consisting generally of mix in place construction using SC-2 liquid asphalt. It is believed that successful results would be obtained with hot premix, as used for bank protection. A list is given of certain basic points which must be considered in the design and construction of asphalt reservoir linings.

Dams and Spillways.—Similar methods have been used for protecting the upstream faces of dams, and are being considered for the impermeable sections and cut-off trenches. A project near Upland, California, will employ an asphaltic membrane the upstream portion extending from the cut-off piling cap through the dam to within 4 ft. of the top. This will consist of a penetration coat of cutback asphalt covered with asphalt-saturated burlap, to which is applied a heavy seal coat of asphalt cement. The upstream face will then be built to the correct slope covering the membrane. Flood-control basins at Los Angeles to collect material eroded at the mouth of canyons have been provided with timber spillways, but owing to excessive abrasion, their life is very limited. Protection has been afforded by coating them with a 3-in. layer of asphaltic concrete reinforced with wire fencing anchored to the timber structure.

Ditches.—Success has been achieved with asphalt linings for ditches carrying irrigation water and for the surface drainage of highways, owing to the prevention of seepage losses and preservation of the structure. The outstanding cause of failure in some linings was weed growth, which can be overcome by sterilization of the banks before lining. To achieve success the sides must not be too steep, while the lining must be well compacted and sealed and preferably given a mineral cover. Penetration, premix methods employing asphalt cements, cutbacks and emulsions have been used with success. In the case of the latter two materials, complete curing is necessary before water is allowed to enter.

Bank Protection.—A compacted 3-in. layer of hot asphaltic premix has been used with success to protect a dike which directs the flow of the Hay Canyon (Los Angeles) into the basin. Erosion of the banks of San Jose Creek (Los Angeles) has also been prevented by using a similar surfacing on the bank and a cut-off below the bank, which was under running water, prepared with 10 × 20 ft. slabs of 2-in. asphaltic concrete, overlapping by 5 ft. Heavy building paper was laid between the slabs to allow them to sink and form a cut-off as undercutting occurred.

Wind-erosion Prevention.—Highway and railway banks of sand and silt have been protected from wind erosion by penetration treatment with low-viscosity slow-curing asphaltic material SC–IA followed by a seal coat of soft asphalt cement. A similar treatment has been applied to a sand dune area through which a portion of the Colorado River aqueduct passed.

C. L. G.

942. Bituminous Emulsion Treatment of Permeable Sub-Soils. Anon. *Petrol. Times*, 21.5.38, **1010** (39), 649.—The Shellperm process as applied in connection with the raising of the Assiut Barrage in Egypt is described. A fine bituminous emulsion, suitably diluted if necessary, is pumped, at low pressure, into permeable sub-soils,

where coagulation takes place after a predetermined period, with the consequent choking of the interstices in the soil. The permeability of the soil is thereby greatly reduced. The rate of coagulation is controlled by the nature and amount of coagulants which are pumped with the emulsion. H. G.

943. Patents on Asphalt. E. B. Tucker and E. W. Thiele. U.S.P. 2,116,772, 10.5.38. Method of depropanizing asphalt separated from lubricating oils.

K. Kell. U.S.P. 2,117,177, 10.5.38. Production of bitumen from oil containing paraffin and hard and soft asphalt. W. S. E. C.

Special Products.

944. Patents on Special Products. G. W. Johnson. E.P. 484,660, 4.5.38. Manufacture of unsaturated hydrocarbons from halogenated hydrocarbons.

N.V. de Bataafsche Petroleum Mij. E.P. 484,884, 11.5.38. Process for concentrating aqueous halohydrin solutions.

N. V. de Bataafsche Petroleum Mij. E.P. 485,485, 20.5.38. Dehydrogenation of secondary or tertiary alcohols and carboxylic acid esters.

T. S. Richardson and P. L. Smith. U.S.P. 2,117,984, 17.5.38. Process of refining wax of predetermined m.pt., 130–133° F. W. S. E. C.

Detonation and Engines.

945. Thermodynamics of the Petrol Engine. W. J. David. *Engineer*, 22.4.38, **165** (4293), 438 and (4294), 464.—An analysis is given of the causes responsible for the drop in the indicated thermal efficiencies of petrol engines below the corresponding ideal efficiencies. The main causes of loss of efficiency are given as :

(1) Heat loss from the working fluid during explosion and expansion.
(2) Incomplete combustion at the peak pressure.

The analysis shows that the loss in efficiency due to incomplete combustion is a minimum in any given engine when the fuel-air supply is about 20% rich. For mixtures less strong, the loss in efficiency due to incomplete combustion increases greatly even in the best engines, and is more serious than that due to heat loss. Heat loss in an engine, although it may be reduced to a minimum by compact combustion-chamber design, is unavoidable, but it is suggested that incomplete combustion at the peak pressure, which is due mainly to incomplete chemical combination, is avoidable, and that complete combustion could be obtained except in the case of weak mixtures, by perfect mixing of the charge before ignition. The author suggests that further research on the design and position of the inlet valve to secure better mixing should prove profitable, and suggests a simple test for the degree of perfection of mixing attained, involving observation of the range of peak pressures obtained with the engine running on a non-detonating, and a detonating fuel respectively, by means of a suitable indicator.

The concluding part of the work consists mainly of an analysis of tests carried out by several notable authorities, in which the measured thermal efficiencies obtained under a wide range of operating conditions are compared with the ideal efficiencies, in the light of the author's views previously expressed. E. F. C.

946. Economies of Cleaning Diesel-Engine Fuels by Centrifuge. H. O. Sears. *Oil Gas J.*, 2.4.38, **36** (49), 70.—Records have been kept over a period of 2½ years by a major pipe-line company of the operating and maintenance costs of five stations with identical equipment, except that two have been equipped with fuel-oil centrifuges. The engines in question were of the slow-speed, air-injection, four-cycle type, which could reasonably be expected to show less trouble from dirty fuel than any other type. Centrifuging was expected to have an effect on exhaust valves, fuel valves, fuel pumps, liner wear, lubricating oil consumption and fuel consumption. The economies resulting were broken up into : (*a*) short-term or frequently recurring maintenance costs, (*b*) long-term costs and (*c*) fuel and lubricating-oil costs.

(*a*) Centrifuging effected a saving of 6½ men. hours per year per cylinder in operation in reconditioning valves, the reconditioning time (three times a year) being reduced from 2 hrs. on exhaust valves and 1 hr. on fuel valves to ½-hr. and ¼-hr., respectively. In addition, the life of valves and valve-seats has been lengthened. Replacement of fuel-pump plungers and valves (annually) and fuel-pump packing (twice a year) has been reduced, it not being necessary to replace the former when using centrifuged fuel after 2½ years, while only one fuel pump packing replacement has been necessary.

(*b*) In engines operating on centrifuged fuel the rings accumulated less carbon, and cases of stuck rings were much less frequent. Liner wear was reduced approximately 50%.

(*c*) The fuel consumption was reduced from 0·434 lb. per H.P. hr. to 0·415 lb., saving 395 brl. of fuel per station per year. The lubricating oil after 100 hrs. operation on uncentrifuged fuel gave 1¾ lb. of carbon and foreign matter on cleaning, and 3¾ lb. of carbon after 150 hrs., whilst that from the engines running on centrifuged fuel gave only 1 lb. carbon after 140 hrs. In addition, a saving of 22 gals. of lubricating oil was effected in the first six months.

It is emphasized that the benefits of centrifuging will be materially increased when fuels containing a higher percentage of foreign matter than that of the fuel tested (analysis of centrifuged matter given), particularly in the case of mechanical injection and higher-speed engines. It also enables a heavier, lower-priced fuel to be used, and gives more even loading of cylinders and lower operating temperatures. C. L. G.

947. Flame Temperatures in Engines. A. E. Hershey. *Chem. Rev.*, 1937, **21** (3), 431.—Among the various methods available for measuring gas temperature in an engine, the spectral-line-reversal methods appears to have certain advantages. Comparison of the maximum combustion temperature found by line-reversal methods with calculated values for a wide range of air-fuel rates provides unsatisfactory agreement, the maximum difference between the two methods being of the order of 1000° F.

The factors affecting the measured temperature may conveniently be divided into the following groups: (*a*) Experimental errors inherent in the method of temperature measurement—*e.g.*, non-thermal excitation of radiation from the sodium atoms; absence of thermal equilibrium between the gases and the sodium atoms; cooling effect of the sodium solution entering the fresh charge. (*b*) Experimental errors in the method as applied to engine temperature measurement—*e.g.*, deposit or film on the cylinder windows; finite time of stroboscopic shutter opening.

The separate effects of these sources of error have been considered, and the conclusion reached that their combined effect could not result in the differences encountered between the observed and calculated temperatures.

It is therefore necessary to examine critically the method of calculating the temperature. In this method two distinct sources of error exist: (*a*) Inaccuracies in the method: incorrect chemical and thermal data for the gases under consideration; disregard of certain dissociation products. (*b*) Departure of operating conditions from assumed conditions for temperature calculations: absence of thermal and chemical equilibrium in the gases; departure from adiabatic, constant volume combustion; temperature gradients in the gases.

If due consideration is given to these sources of error in the two methods of obtaining gas temperatures, it appears that reasonable agreement between measured and calculated results may be obtained for gas temperatures in an engine during combustion and expansion. H. E. T.

948. Engine Bearing Temperatures. C. G. Williams and J. Spiers. *Engineer*, 6.5.38, **165**, 505; 13.5.38, **165**, 548.—The influence of various operating and design factors in regard to bearing temperatures was examined in a two-litre six-cylinder petrol engine operated at speeds up to 3,000 R.P.M., the lubrication system of which was modified to operate on the "dry-sump" principle to give greater flexibility of control.

The temperatures of No. 1 crankpin and of Nos. 1 and 2 main bearings, and of the oil supplied to these parts, were obtained by means of copper-constantan thermocouples, four being inserted in the crankpin and two in the cap half of the main bearings. Couples were also inserted in the oilways to these bearings, as near as possible to the point of entry of oil to the bearing. The leads from the crank-pin couples were

brought through the hollow front end of the crankshaft to slip rings, the brushes of which were connected to the measuring instrument.

The temperatures observed suggest that an appreciable proportion of the temperature rise of the lubricant may occur not at the actual bearing surfaces, but in hot oilways through which the lubricant passes on its way to the bearings.

Experiments on the effect of inlet temperature showed that a given decrease or increase in oil-inlet temperature had approximately the same effect on all the other oil and bearing temperatures measured, whilst during the study of the effect of rate of oil circulation it was found that the temperature rise of the lubricant was roughly inversely proportional to the rate of oil circulation.

Both crank-pin and main bearing temperature increased linearly with engine speed, although the lower-viscosity oils gave considerably less increase in the temperature with speed. It is therefore suggested that the use of an oil of lower viscosity may, under certain conditions, extend the useful life of a bearing. The lighter oils also showed a considerably smaller decrease in actual operating viscosity with increase in engine speed, in addition to reducing the frictional losses in the engine. There was comparatively little change in bearing temperatures over a fairly wide range of engine load. E. F. C.

949. Highest Frequency of Torsional Vibration. G. G. McDonald. *Engineer*, 13.5.38, **165**, 542.—The author describes a simple graphical method he has devised for locating the nodes for the highest frequency of torsional vibration in an " ideal " system, comprising a number of rigid mass moments of inertia spaced in any manner along an inertialess shaft of uniform torsional elasticity.

The process is a trial-and-error one in which a framework of straight lines involving a simple calculation for each mass is first drawn; the search for the nodes is carried out by drawing on the framework a number of straight lines in a certain sequence, and if the position of the starting-point of the figure has been correctly chosen a closed diagram results. The positions of the nodes are then indicated at the points on the line representing the shaft length, where this is met by the perpendiculars of the figure. When the " closing node point " has been determined to a satisfactory degree of accuracy, the highest frequency is obtained by making a final calculation.

The graphical process is illustrated by its application to two fundamental systems—viz., the single mass fixed-free system and the single-mass fixed-fixed system—also to various combinations of these. E. F. C.

950. Mollier Diagram for the Internal-Combustion Engine. H. C. Hottel and J. E. Eberhardt. *Chem. Rev.*, 1937, **21** (3), 439.—Quantitative calculations of the effects of flame propagation, and of piston movement, on the temperatures attained in the various parts of an Otto-cycle engine charge during combustion are simplified by the use of a Mollier diagram of the properties of the combustion products of octane and air. The method is applied to a consideration of the effect of spark advance on the temperature attained ahead of the flame front, and it is concluded that the results are of some importance in the study of engine knock. H. E. T.

951. Power Plant Trends. G. J. Mead. *J. R. aero Soc.*, 1937, **41**, 997–1024.—The present trend, both in land transport, planes and flying-boats, is towards machines of much greater size than those at present employed, with higher cruising speeds and engines of higher output per litre and greater take-off power. The author believes that present progress in engine design can be maintained. He predicts the general adoption of 100 octane fuel in place of the 87 octane now used by airline operators in the U.S.A. There is a tendency towards smaller cylinders and higher operating speeds, permitting of smaller total displacement and reduction of cross-sectional area, and present progress in fuel economy leads to the prediction that service consumption of 0·4 lb./B.H.P. hr. may be achieved in the next few years. Improvement in cooling has lessened the losses from drag, and this loss should be further reduced with the newer-type engines. Growth of aeroplane sizes and improvement in engine performance over the past ten years, also the effect of octane rating and compression ratio on performance, are shown graphically. The gradual evolution of each of the major engine components is dealt with at length, and the article is profusely illustrated. C. H. S.

Synthetic Processes.

952. Production of Hydrocarbon Oils from Industrial Gases. Anon. *Chem. Age*, 21.5.38, **38**, 404.—In a paper read before the Institute of Fuel, Dr. W. W. Myddleton described the theoretical basis and operating conditions of a process developed by Synthetic Oils, Ltd., for the production of motor spirit, diesel fuel oil and unsaturated hydrocarbons suitable for lubricating oil synthesis from a gas containing CO and H_2 in a ratio of between 1 : 1 and 1 : 5. The first product of reaction (primary oil) consists of olefines, which then become hydrogenated as they pass through layers of catalyst in the presence of hydrogen in the residual gas. Nickel catalysts produce a paraffin type oil by the hydrogenation of the olefins (*e.g.*, a spirit of O.N.32), whereas with cobalt less hydrogenation takes place. With blue water gas, however, nickel catalyst produces a spirit of 65 O.N. The reaction proceeds at atmospheric pressure, and it is not necessary to purify the gas to a high degree, owing to the catalyst being stabilized towards sulphur poisoning. The plant in use handles 100 cu. ft. of gas an hour, the first products of reaction being a gas laden with a fog of oil and wax, which is removed by a relatively low-voltage electrical precipitation process giving an oil of I.B.Pt. about 98° C. The gas is passed to a scrubber or to a second catalyst chamber, yielding 0·9 gal. of a product with an I.B.Pt. of 30° C. per 1000 cu. ft. of gas.

The advantages claimed for this process are : (1) by limiting the hydrogenation of the primary oil of synthesis, satisfactory motor spirit can be produced without cracking and also diesel fuel oil, (2) the amount of material available for the production of lubricating and transformer oils is increased ; (3) it is not necessary to adjust the CO and H_2 ratio of the synthesis gas, which can be obtained from most solid fuels ; (4) the catalyst used is resistant to sulphur poisoning.

A commercial plant is nearing completion at Bedlay Colliery near Glasgow to treat 150,000–200,000 cu. ft. of gas per day, producing 136–180 gals. per day of synthetic oil, in addition to wax and olefinic still-head gases which will increase the value of the output. C. L. G.

Oil Shale.

953. Bituminous Shales at the Base of the Toarcian in the East of France. M. Bursaux. *Ann. Off. Combust. Liq.*, Jan.–Feb. 1938, **13** (1), 9–51.—Bituminous shales occur in the Nancy–Strasbourg region, the outcrops running along the margin of the Paris basin and of the Saône basin. These deposits die out beyond Montmédy, and are cut off by a fault in the S.E. The bulk of the investigations have been made along the outcrops, but the Errouville boring was about 10 km. from the outcrop. Work began before the Great War, and has been carried out in considerable detail since, involving the making of many shallow borings and pits, geological mapping and the laboratory testing of the shale samples. The oil productivity was tested by the Fischer method, which entails rapid heating to 350° C. and then gradual heating to 450° C. 12–15% greater oil recoveries were obtained with superheated steam, but this method is less reliable and slower.

The bituminous zone is at the base of the Toarcian, and is well defined palæontologically. A kind of boghead, a few millimetres thick and giving 32% of oil, has been noted by some in the middle of the Harpoceras falciferum zone, whilst in the Créveney–Bourmont and Chatenois–Vandières areas the roof is formed of several decimetres of phosphatic nodules with ammonites. The beds are best developed in the syncline between the Crusnes and Fontay faults and the Sion syncline, but are thin and of poor quality on the Langres anticline. The oil content seems to run parallel with the variations in thickness, except for the Montenoy–Sainte Geneviève region, where it is high and independent of the thickness.

There are four main zones to be considered. The Créveney area is best known, and is estimated to have 250 million tonnes of shale which can be worked open-cast, and have an average oil content of 4%. The Grimonvillers area appears to have about 200 million tonnes of shale of slightly better quality (4·4%), but these estimates require checking by further work. The Montenoy–Sainte Geneviève area is not fully known, but the beds seem to be thicker and of better quality than the above. At Errouville the highest-quality shale has been found, but data are available for only one point. Outside these four zones further work seems of no use. The Errouville figures approach

workable values, but in the other areas the oil content, thicknesses and disposition are against economic exploitation under present conditions.

Curves are included showing the variations of thickness and oil content from place to place. There are five maps showing the sites of the borings and the logs of thirty-six wells showing the lithology, oil content for samples at different depths and the mean oil contents. G. D. H.

Historical.

954. Petroleum in Greek and Roman Antiquity. A. Séguin. *Revue des Questions Historiques*, Jan. 1938, 36–71.—This article is a report, read by the writer during the Second World Petroleum Congress (Paris, June 1937). On the strength of data found in classic literature, the author first traces the origin of various expressions such as "asphaltos," "bitumen," and "naphtha." In doing this he extends his investigations to the oldest inscriptions in Asia Minor and Egypt. Next an extensive translation is given of part of the information on the seepages of oil and bitumen from classical sources, which information is checked with the aid of the modern geological investigations and data available from former ages. Here it appears again that the Ancients principally sought their wells in Mesopotamia, Persia and the Dead Sea. Further, seepages are mentioned in Asia, Africa and Europe, but the information on these sources is not always very clear. R. J. F.

BOOK REVIEWS.

About Petroleum. By J. G. Crowther. Pp. xiv + 181. Oxford University Press. London 1938. Price 7*s.* 6*d.*

The title aptly describes the book. It does not aspire to be a descriptive text-book of the petroleum industry, nor is it. Its aim is to give a general idea of the methods and processes of production and refining to those of the general public, such as motor drivers, airmen, mechanics, users of domestic fuels and the many others to whom petroleum is of interest. It does not cover the ground completely, as the housewife will find little on kerosine and the road-maker nothing on the use of asphalt. The book shows a lack of balance, in that full treatment is meted out to such subjects as helium and carbon black, whilst others of some importance receive insufficient attention.

The book is well written and makes very pleasant reading, it is up to date and contains much interesting information which may have escaped the petroleum man whose interest lies only in one section of the industry. The technical reader will find points to criticize, but the book is not written for such, and must be judged by the extent to which it fulfils the purpose for which it is written.

The writer is to be congratulated on having produced a book which will be of interest and service to the general public, whose interest in petroleum is not as great as it would be if the United Kingdom were a producing country.

J. KEWLEY.

Motor Benzole—Its Production and Use. W. H. Hoffert and G. Claxton. Pp. xxv + 933, Illus. 247. 2nd Edition, 1938. National Benzole Association, London. Price 42*s.*

This is the second edition of *Motor Benzole*, published by the National Benzole Association, and represents a very considerable enlargement of the first edition, which was published in 1931. While the book is principally devoted to benzole and its production and utilization, a number of subjects of allied interest are also very fully dealt with. The production of aromatic hydrocarbons from other sources than coal—as, for example, those naturally occurring in petroleum and those obtained by cracking and hydrogenation processes—is also fully discussed. In view of the large proportion of benzole used as motor fuel, a chapter is given on the principles of the internal combustion engine and on the use of benzole in blends with gasoline and alcohol. The standard specifications for motor benzole in all the more important countries of the world are also given, together with the standard methods of test and analysis. Similarly the question of safety precautions and the storage and handling of benzole is also discussed. A very useful chapter gives a list of tables and data covering most of the information likely to be required by those concerned with benzole. In addition, full reference is made to the chemical-engineering process associated with benzole recovery, and, in view of its connection with the removal from coal gas, one chapter is devoted to the removal of naphthalene from town gas.

The book as a whole has been very carefully edited—for example, a list is given of the journals to which reference has been made in the book, together with six of the more prominent libraries in London in which the book can be found. A list of the abbreviations used in the book is given, and the index, subdivided into index to names and index to subjects, is very complete, and covers some fifty-five pages.

The second edition of *Motor Benzole—Its Production and Use* is the most complete source of information on its subject, and in view of the full treatment of the production and utilization, will be of very great value to a much wider field than that of motor benzole alone.

F. H. GARNER.

Polymerization and Its Applications in the Fields of Rubber, Synthetic Resins and Petroleum. By R. E. Burk, H. E. Thompson, A. J. Weith and I. Williams. Pp. 312. American Chemical Society, Monograph Series, No. 15. Reinhold Publishing Corporation, New York, U.S.A., 1937. Messrs. Chapman and Hall, Ltd., London, W.C.2. Price 25*s.*

This work is another example of the excellency of the American Chemical Society's monographs in which the authoritative standing of the authors is combined with the critical examination of the editors. More and more is it being felt that in the vast field covered to-day by the various branches of science there is need of skilful interpretation, and these monographs give this valuable service to the general body of chemists, as well as to those employed in a particular and special line of investigation.

The present volume is concerned with polymerization in a variety of fields of research, in hydrocarbon chemistry, and in the rubber, petroleum, resin and paint industries. Two points of view have been studied: the fundamental theoretical field that forms the living background of commercial development and the day-by-day practical *ad-hoc* problems that are always in front of the industrial chemist. The balance has been well maintained.

The main outlines are concerned with the relation between molecular structure and the rate of polymerization in such systems where unsaturation, conjugation, effect of the carbonyl group and similar centres of reactivity are present.

Subsequent chapters deal with catalysis, the mechanism of polymerization, the structure of polymers, polymerization in the rubber industry, polymerization and synthetic resins, and polymerization in the petroleum industry. This final chapter will be found of great interest to our own readers. It contains well-written and informative sections on acid treating, polymerization by clays and other mineral adsorbents, application of aluminium chloride, deterioration phenomena in gasolines, kerosines and lubricating oils, synthetic products from cracked gases, both low and high in molecular weight, including resins, lubricating oils and gasolines.

The book is well indexed, and amply provided with references to the already vast literature. As a pertinent example may be quoted pp. 54—113, which contain tabular matter relating to the effects of catalysts on a great mass of reactants, reaction conditions and products.

The printing and get-up are admirable. A. E. DUNSTAN.

BOOKS AND PUBLICATIONS RECEIVED.

The Friction of an Oscillating Bearing. By A. Fogg and C. Jakeman. D.S.I.R. Lubrication Research Technical Paper No. 3. Pp. 28. H.M. Stationery Office, London. Price 9*d*.

This report records the results of experiments made at the National Physical Laboratory on behalf of the Lubrication Research Committee in an endeavour to elucidate the effect of the various factors that determine the friction of an oscillating bearing. Results are described of variations in the three main factors influencing friction—viz., speed, load and temperature. These were varied over fairly considerable ranges, and, in addition, a number of lubricants, including mineral, fatty and compounded oils, were used. It was evident from the results that over the whole range of conditions investigated the friction was dependent on certain characteristics of the lubricant other than its viscosity. The chemical composition of the lubricant was found to play an important part in the lubrication of the bearing at all frequencies.

An Investigation into the Causes and Prevention of the Corrosion of Tar Stills. By D. D. Pratt, H. C. K. Ison and R. G. Wood. D.S.I.R. Chemistry Research Special Report No. 4. Pp. v + 30. H.M. Stationery Office, London, 1938. Price 9*d*.

An investigation carried out at the Chemical Research Laboratory comprising the identification and isolation of tar constituents responsible for the corrosion of tar stills has shown that it is the benzene-soluble resinols which are most active in promoting corrosion at high temperatures. In the presence of ammonium chloride the activity of these materials is intensified. To combat the deleterious effect of these bodies a technique has been explored whereby the amorphous resinoids are precipitated, leaving for distillation only the oily fractions of the tar. A long series of distillations in experimental stills has been carried out on the petroleum extract of a corrosive tar, and it has been established that the corrosion caused by this

fraction is much less than that manifested when a so-called "non-corrosive" tar is distilled.

Failing preliminary treatment of tars, a solution to the problem of corrosion of stills must lie in the direction of finding a constructional material capable of standing the action of the corrosive constituents. Efforts to develop a protective coating for mild steel were unavailing, but certain nickel-chromium steels and stainless steels were found to be very resistant.

Geology and Ore Deposits of the Bayhouse Region, Custer County, Idaho. By C. P. Ross. U.S. Geol. Survey Bulletin, 877. Pp. vii + 161. Index + Map. Superintendent of Documents, Washington, D.C. Price $1.00.

Co-operative Fuel Research Motor Gasoline Survey, Winter 1937-38. Compiled by E. C. Lane. U.S. Bureau of Mines. Report of Investigations, 3408.

Characteristics of regular-price, premium-price and third-grade motor gasolines are reported, based on inspections made in the laboratories of various oil companies and submitted to the Bureau of Mines for compilation and comment.

Methods for the Detection of Toxic Gases in Industry. Leaflet No. 2. Hydrogen Cyanide Vapour. Department of Scientific and Industrial Research, 1938. Pp. iv + 9. H.M. Stationery Office, London. Price 5*s.* 6*d.*

The method of test adopted consists in drawing a sample of the suspected atmosphere by means of a hand-exhausting pump through a piece of specially prepared test-paper. Full instructions for preparing the test-paper and for carrying out the test are given in the leaflet. The various reagents which will react to hydrogen cyanide are reviewed, and those recommended are Congo-Red–silver nitrate and benzidine–copper–acetate, which are capable of detecting concentrations down to 1 part in 100,000. Test-papers treated with these reagents will show characteristic stains, specimens of which are included with the leaflet. Both reactions have been made quantitative, and have been developed as standard tests for hydrogen cyanide in industry.

British Standard Specification No. 802, for Tarmacadam. May 1938. Pp. 19. British Standards Institution, 28, Victoria Street, London S.W.1. Price 2*s.* 0*d.*

Part I of this Specification refers to the supply of graded tarmacadam in bulk and covers three types of material: (*a*) ordinary process, (*b*) semi-hot process and (*c*) hot-process Tarmacadam, which differs in grade and quantity of binder and the temperature of mixing and laying. Part II of the Specification refers to the surfacing of roads with Tarmacadam.

British Standard Code No. 799 for Fully Automatic Oil Burning Equipment for Central Heating and Hot Water Supply. May 1938. Pp. 28. British Standards Institution, 28, Victoria Street, London, S.W.1. Price 3*s.* 6*d.*

This code applies to fully automatic oil-burning equipment for domestic oil-burning installations for central heating and hot-water supply. The equipment specified is suitable for fuel oils conforming to Grades A and B of B.S.S. 742 "Fuel Oils for Burners," and having a closed flash point of not less than 150° F.

The Mineral Industry of Alaska in 1936. By P. S. Smith. U.S. Geological Survey Bulletin 897 A. Pp. 107 + map. Superintendent of Documents, Washington, D.C. Price 30 cents.

No petroleum was produced from any Alaska deposits in 1936, and searches for new oil-fields, which had been active a few years before, have been practically discontinued. In so far as reports were made to the Geological Survey, only one company was drilling in the entire Territory during 1936.

Geology and Mineral Deposits of the Snowmass Mountain Area, Gunnison County, Colorado. By J. W. Vanderwilt. U.S. Geol. Surv. Bull. 884, Pp. viii + 184. Index and Map. Superintendent of Documents, Washington, D.C. Price $1.00.

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Geology.

955. Recent Petroleum Development in Illinois. A. H. Bell and G. V. Cohee. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 649–658.—Previously few wells in this area had entirely penetrated the Pennsylvanian sediments, and only very generalized structural maps or sections could be prepared from the few logs then available.

The new drilling is now furnishing data of much value in connection with subsurface stratigraphy and structure of Illinois, particularly for the central-basin area. Most of the new wells penetrate the Ste. Genevieve limestone (Lower Mississippian) and a few of the Devonian or older rocks. Brief mention is made of the more important tectonics of the area and a cross-section is given across the Centralia monocline, through the Clay City and Noble anticlines to the La Salle anticline.

Since May 1937 approximately 4 million brls. of oil have been produced from the new fields, whilst in the new areas there are indications that reserves will exceed 100 million brls. G. S. S.

956. Recent Developments in Michigan Basin. E. A. Newman. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 659–665.—In the Southern Peninsula of Michigan new oil- and gas-fields have been discovered over widely separated areas. These areas range from Salem Pool in Allegan Co. in the S.W. to the Clayton Pool, Arenac Co., in the N.E., a distance of approximately 135 miles.

Main production has so far been restricted to the central and deeper parts of the basin, the principal producing horizon being the Dundee formation. In Midland Co. the discovery well had an initial production of 1028 brls. per day from this horizon.

Discoveries of new fields can be expected to increase during the next few years. Exploration for oil and gas in the Devonian may tend to expand outward from the central part of the Michigan basin, whilst possibilities of new tests being made in the Silurian and Ordovician formations are also considered likely. G. S. S.

957. Developments in Kansas in 1937. R. G. Moss. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 666–676.—Nearly seventy new pools and important extensions to old pools were discovered during 1937. Lansing–Kansas City limestone and the Arbuckle dolomite constituted the most important producing horizons, and these were responsible for two-thirds of the new discoveries. Half of the new pools and 80% of the estimated new reserves were restricted to Barton, Ellis, Rice and Russell counties on the Central Kansas uplift.

The chief geological exploration during the year consisted of core-drilling and seismograph work, including investigations with the torsion balance, and surface-structure mapping.

Interesting stratigraphic data were obtained in wells in Western Kansas. In Jefferson Co. (Nebraska), also, similar important information was furnished. A well begun in the Greenhorn (Cretaceous) limestone penetrated Dakota sandstone to 600 ft., and the base of the Pennsylvanian was reached at a depth of 2550 ft., the well being abandoned at 3344 ft. in sandy Arbuckle. G. S. S.

958. Western Kansas Expansion Continues. F. B. Taylor. *Oil Wkly*, 8.8.38, **90**, (9), 17–20.—Exploration in Kansas is gradually extending from the Central Uplift into the flanking basins. Several wells have been drilled to the N.E. of the Arch on the edge of the Saliva Basin without any success, but only three of them were carried deep enough to be conclusive tests. The Nemaha Ridge is of late Mississippian age, and its formation may have influenced later deposition. Several horizons known to be productive elsewhere have been discovered.

On the S.W. flank of the Uplift nosing conditions occur, and several fields have recently been discovered. Production is obtained from the Misener Sand and the Arbuckle Lime. Farther from the Uplift the beds dip gradually into the Dodge City Basin, and here production has been obtained from the Viola Lime at 6480 ft. and the Mississippi Lime at 4658 ft. Other wildcat wells in the southern portion of this basin have found a little production in the Wilcox formation and encourage further exploration.

Reserves in the western half of Kansas are now estimated at 325 million brls., of which 80% is in the limestone reservoirs and the remainder in the sand. Water-drive is stated to be the main source of energy in the limestone reservoirs. J. A. G.

959. Developments in Rocky Mountain Region in 1937. E. H. Hunt. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 677–693.—Although operations throughout the Rocky Mountain region during 1937 fell below the 1936 level, important developments occurred. The most important result was the discovery of oil in economic amount in the Lower Jurassic (?) Morrison formation at 6664–6693 ft. on the Wilson Creek dome, Moffat Co.

Another notable development was the discovery of substantial reserves in the Pennsylvanian Minnelusa formation in the old Lance Creek field, Niobrara Co., Wyoming. In Wyoming, also, four new gas-producing areas were drilled, the chief of these being the East Allen Lake field, where two wells gave an initial production of 20 million to 40 million cu. ft. per day at a total depth of 2045 ft. in the Jurassic Sundance formation.

Active exploratory work was carried out during the year. This included both surface and geophysical investigations, ten companies having seismic crews in the field. G. S. S.

960. Discoveries and Additions to Oil Reserves in California during 1937. H. W. Hoots. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 701–718. During 1937 discoveries in California consisted of nine new fields and new zones in three fields, these discoveries and extensions adding an estimated 322 million brls. to the State's reserve oil supply for the year. This success in adding to reserves a larger quantity of oil than was produced during the year is due (1) to greater and more effective methods of geological exploration, particularly to the use of the reflection seismograph, and (2) to more active and deeper wildcat drilling. G. S. S.

961. Developments in West Texas and South-Eastern New Mexico in 1937. H. P. Byee, B. R. Haigh and T. Cole. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 694–700.—Drilling operations in S.E. New Mexico and W. Texas were 62% greater during 1937 than those in 1936. Most of these operations, however, may be classed as field wells. New Mexico had forty-three wildcats, five of which were producers, whilst W. Texas had 166 wildcats, thirty-eight being oil-producers.

In New Mexico the Vacuum field (Lea Co.) was extended S., and three new minor areas could be classed as discoveries. W. Texas had its principal active regions in the Goldsmith and Harper areas (Ector Co.), the Wasson–Denver area in N.W. Gaines and S.W. Yoakum and the Jordan area along the Ector–Crane Co. line between Penwell and Waddell.

Statistical tables giving pipe-line runs in barrels and drilling operations in the two States accompany the paper. G. S. S.

962. Developments in South Arkansas and North Louisiana. H. K. Shearer. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 719–727.—During 1937 a general increase took place in oil and gas exploration, development and production. Oil production in Arkansas was 12,159,440 brls., 14·1% more than in 1936, the largest production for five years and the first increase since 1925. In N. Louisiana, production was 28,668,070 brls., 7·1% more than in 1936, and the largest since 1922.

Schuler and Buckner oilfields and an important extension to the Rodessa field were discovered in Arkansas. Two new gas and distillate fields were discovered in Louisiana, and extensive development of the Cotton Valley deep sand and the Lisbon field occurred.

Brief reference is made to the pre-Trinity or early Mesozoic formations; details of these beds it is stated are being published later. G. S. S.

963. Big Things May Come from New Sparta-Wilcox Trend. J. D. Todd and F. C. Roper. *Oil Wkly*, 25.7.38, **90** (7), 78–86.—The Sparta formation is a sandy series at the base of the Cook Mountain formation of Lower Eocene age. It is exposed in

N. Louisiana, where it is represented by a grey to brown sandy clay series of continental origin, the upper portion containing beach and dune deposits. It is normally unfossiliferous, and may contain about 3% glauconite with a little lignite and carbonaceous material. It also outcrops in Texas, where it is an unconsolidated sand of unusually high permeability which has allowed meteoric waters to penetrate far down-dip.

The formation underlies most of Louisiana and Texas. Its maximum thickness is 600 ft., and it thins out rapidly S.W., but in the opposite direction thickens to a maximum of 600 ft. Down-dip it may become marine. At Ville Platte it has a total thickness of 500 ft., of which 35% is sand, 60% sandy shale, and the remainder lignitic shale with glauconitic and carbonaceous material. The producing section averages about 64 ft. in thickness.

The Wilcox formation, also of Lower Eocene age, lies just above the Midway Series. It is made up of non-marine sands, clays, sandy shales with some lignite, carbonaceous and glauconite material. The upper portion contains sand beds varying in thickness up to 100 ft., which are for the most part of continental origin, but may contain occasional marine bands. It is from these upper sands that most of the production is now being obtained. In Texas the Wilcox has been penetrated to a depth of 900 ft., and up-dip its total thickness is probably about 2000 ft. The subsurface extent of the formation is not known, but it has been identified in Alabama and near the Rio Grande river.

It is predicted that many prolific fields will be discovered in these two series, and exploration work for favourable structures is in progress. J. A. G.

964. Résumé of Development in East Texas during 1937. E. A. Wendlandt and C. L. Herold. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 728–735.—In E. Texas, during 1937, three oil-producing areas and three gas and gas-distillate areas were discovered. A total of 3452 wells were drilled. Two fields were extended and deep tests were drilled in a number of fields.

Many of the important exploratory wells penetrated the Lower Glen Rose and Travis Peak formations (Lower Cretaceous), whilst some of the deeper tests supplied important data concerning the Trinity and pre-Trinity (?) stratigraphy of the E. Texas Basin. Certain wells, moreover, penetrated beds previously unknown in this area. G. S. S.

965. Gulf Coastal Developments in 1937. O. L. Brace. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 736–749.—The number of discoveries during 1937 exceeds by a very large margin the record of any previous year, both in total of new fields and in reserves represented by these discoveries.

Texas (15) and Louisiana (14) almost equally divide the twenty-nine new productive areas, although Louisiana takes the lead in the case of new reserves represented. Most of the discoveries are due immediately to geophysical exploration.

In the coastal area five general productive stratigraphic intervals occur: Sparta–Carrizo–Wilcox, Cockfield–Yegua, in the Jackson and intermediate zones, and Vicksburg (*Marginulina*-Frio and Miocene) in the deep coastal zone.

Deep drilling along the Gulf Coast still holds out possibilities of vast potentialities in horizons lying below the present levels of exploration. Wells in the delta area of Louisiana prove commercial production at depths approximating to the world's record for drilling, and it is acknowledged that several thousand feet of unexplored potential zones remain below these depths. G. S. S.

966. Activities in South Texas, 1937–1938. S. Mossom. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 750–757.—The year 1937 resulted in the discovery of forty-six new producing areas and sixty-eight new productive horizons in older fields. Of the discoveries, eighteen were in the coastal area, eighteen in the Jackson zone, and nine in the fault line.

Included in the most important fields discovered, are: N. Sweden (east-central Duval Co.), Killam–Oilton (Webb Co.), Ezzell (N.E. McMullen Co.), Luby (Nueces Co.), and E. Premont (Jim Wells Co.).

Concluding remarks refer to the Frio section tending to become of increasing importance as a leading objective for wildcatting. G. S. S.

967. Forest City Basin. A Comparison with the Illinois Basin. W. G. Osborn. *Oil Gas J.*, 11.8.38, **37** (13), 27–29, 34.—The Forest City Basin lies to the W. of the Illinois Basin and is separated from it by the Nemo Uplift. Its western limit is the Nemaha Uplift, whilst the Ozark and Dakota Uplifts form the southern and northern boundaries respectively. On the basinwards side of the Nemaha Uplift, and parallel to it, a deep trough occurs which is probably an old foredeep similar to those now bordering some of the continental masses.

Folding and faulting movements within the basin may be divided into three groups: (1) Those associated with the surrounding uplifts, (2) A N.-S. series associated with the general folding noted in the Mid-Continent area, and (3) a concentric series of movements with the focus apparently situated in E. central Wisconsin. Group (1) is thought to be of the greatest importance with regard to oil and gas accumulation.

The stratigraphy is similar to that of the Illinois Basin except for a greater lapse in the Mississippi sedimentation resulting in the absence of the Chester–Mississippian formations.

Oil shows have been reported from the Upper Ordovician, Silurian, Devonian and Pennsylvanian. The last-named is probably petrolifierous over most of the basin, but the oil so far found in the northern area is very heavy. Southwards the chances of finding better-quality oil are much higher.

Most of the basin is masked by a glacial overburden which makes geological work difficult, and it is only by the use of geophysics that the detailed structure can be discovered. J. A. G.

968. Southern Minnesota Geology Studied for Oil Indications. G. A. Thiel. *Oil Gas J.*, 28.7.38, **37** (11), 57–58.—The structure of this area is a monocline gently dipping S.E. and actually lies on the western limb of a gentle syncline extending from Cannon Falls south-westwards into N. Iowa. Although slight folds are present, insufficient is known to give a detailed description of the structure.

The stratigraphy is as follows: Over the pre-Cambrian granite and shales there is a series of Cambrian sandstones and shales with a total thickness of about 525 ft. Above these occur 750 ft. of Ordovician limestones, dolomites and shales with a little sandstone. Then comes 200 ft. of Devonian limestone overlain by glacial and recent deposits.

The Ordovician strata are abundantly fossiliferous, and are probably of approximately the same age as the Trenton formation of Ohio, but lack of cover has allowed erosion to dissect them to a great extent. Although the St. Peters Sandstone (Ordovician) and the Jordan Sandstone (Cambrian) have a good porosity, the former is exposed over large areas and the latter is not associated with any possible source rocks.

The only gas indications occur in the glacial drift, and it is concluded that the area is of no interest from a commercial point of view. J. A. G.

969. Alaska now Looming as Attractive Potential Petroleum District. T. P. Sanders. *Oil Gas J.*, **37** (10), 21.7.38, 14, 15, 106.—The Iniskin test-well situated at Cook Inlet has now reached a depth of more than 6600 ft. and has encountered a number of oil shows during the last 2000 ft. of drilling. The base of the Jurassic has not yet been penetrated, and it is probable that the source-beds of the oil shows occur in the underlying Triassic beds. The Iniskin anticline is about 12 miles long, and is deeply eroded. It is not unlike the Kettleman Hills North Dome structure.

The test-well situated on the Bear Creek anticline has been commenced. This structure is a large anticline running N.E.–S.W. and covers an area of 10,000 acres with a closure of 1700 ft. The Pearl Creek and Hubbell structures are located about 15 miles W. of Bear Creek on a parallel fold. Oil seepages occur on all these three structures.

The Cordova–Katalla district in the S. central part of Alaska is considered very favourable. Tertiary sediments are exposed at the surface, but the wells drilled some years ago did not go much below 1000 ft., and little is known of the stratigraphy of the area. Several structures have been discovered, and drilling is expected to commence in the near future. J. A. G.

970. Possibilities of Petroleum Deposits in the Western Urals. D. M. Preda. *Monit. Petr. roum.*, 1938, **39**, 685–687.—Although not yet proved, there appears to be evidence of rich petroleum deposits in the Western Urals. The evidence and possibilities are discussed. T. C. G. T.

Drilling.

971. Accurate Drilling Records Kept on N. Louisiana Wildcat. G. Weber. *Oil Gas J.*, 26.5.38, **37** (2) 42.—The Magnolia Petroleum Co. No. 1 Sexton unit, a N. Louisiana wildcat, is drilling below 10,400 ft. and the most modern type of heavy equipment is being used. In addition, very accurate records are being kept of its operation. The making of time-drilling logs of the well below 4500 ft. has been a valuable practice in aiding the interpretation of geological data and in determining bit efficiency.

Wire-line coring was adopted, and resulted in the saving of considerable time. Any cores which show indications of saturation are bottled for porosity, permeability and saturation tests in the laboratory.

A protective string of 9⅝-in. casing was set at 6814 ft., and from this depth to the present depth the hole measures 8¾ in.

Artificial mud was added daily after passing 10,000 ft., and this keeps the mud at approximately 11 lb. and the viscosity is maintained at 26. The bottom-hole temperature is estimated at over 250° F. L. V. W. C.

972. San Joaquim Drilling Time Reduced by Improvements. T. P. Sanders. *Oil Gas J.*, 2.6.38, **37** (3), 44.—Attention has been paid to drilling economies in the Ten Section field, San Joaquim Valley, and drilling time has been cut from 5 months for the discovery well to 38 days for the last well to be put into production. These wells are over 8000 ft. deep, and have two strings of casing cemented.

Heavy drill collars were used, and approximately one-third of the total drill-collar weight is held up, whilst two-thirds is applied to the bit. It is stated that by this means excessive whipping at high rotary speeds is eliminated. A reamer is placed at the top of the group of drill collars, and with the drill-pipe kept in tension, this has proved beneficial towards straight drilling. Greatly increased speeds of drill-pipe rotation are noticeable, and speeds of 250 and 300 r.p.m. are maintained during much of the drilling.

A new cementing practice was devised to enable the casing and a bridge to be installed.

Some of the reduction in drilling time may be due to smaller hole size.

L. V. W. C.

973. Determining Water Content of Cores. M. D. Taylor. *Oil Gas J.*, 6.6.38, **37** (5), 59.—The presence of water in oil-bearing formations is an important factor which must be considered in estimating oil reserves and in calculations on the flow of oil to wells.

The normal methods for the determination of water in core samples demand large cores, and in addition there is the possibility of error due to the inclusion of water of hydration with the liquid water present in the pores of the formation. In view of the fact that the water content of an alcohol solution can be easily determined with high accuracy by means of a critical solution–temperature measurement, an application of this method for water determination to the analysis of core samples has been tested and found suitable for either large or small samples. The time required is only 10 to 15 mins.

The procedure which has been developed is fully described. L. V. W. C.

Production.

974. Production of Petroleum by Shafts and Galleries in the Sarata-Monteory Field. V. Velehorsky. *Monit. Petr. roum.*, 1938, **39**, 671–680.—Apart from Pacureti in Moldavia, the Sarata-Monteory is the oldest operated field in Roumania. Oil, which occurs at very shallow depth, has been produced since 1840, when it was used locally as cart-grease. The first wells were of the primitive type, the oil being bailed out with wooden buckets. Some of these wells struck oil at 10 metres.

Following an outline of the geology of the area, there is a description, illustrated with diagrams and photographs, of the shaft-and-gallery system adopted in 1925 for producing oil. The shaft is sunk to the producing sands, and along the upper part of this level are extended horizontal galleries.

Sumps are constructed along these tunnels, and the oil which drains into them is pumped to the surface. Methods of ventilation and lighting are described.

T. C. G. T.

975. Acid Treatment of Gas Wells to Increase Production. M. E. Chapman. *Oil Gas J.*, 19.5.38, **37** (1), 107.—During the early days of acid treating of gas wells the usual procedure was to introduce acid into the well at the casing-head, and then the acid solution was driven into the producing formation by the use of compressed air or gas. The latest innovation in the treating of gas wells is to use water behind the acid as a pressure medium. Only sufficient water is placed behind the acid to balance the bottom-hole pressure, and thus drive the acid into the producing formation. During treating three or four pumping units are used. All the pumping units are arranged to deliver the treating solution and subsequently the water load. A bailer or swab is run following the treatment, and sufficient water is taken from the top of the water column to unbalance the bottom-hole pressure. The rapidity of this type of treatment apparently accounts for the successful results which have been obtained.

Better results are achieved if the acidulated mixture is forced into the producing formation at a rapid rate and if the wells are quickly reversed and the closed-in period is reduced. L. V. W. C.

976. Large Brine-Disposal System Placed in Operation in Hendrick's Field. M. Tucker. *Oil Gas J.*, 2.6.38, **37** (3), 61.—The world's largest salt-water-disposal system has recently been put into operation in the Hendrick's Pool or Winkler County, W. Texas. High percentages of water are encountered. Wells having fluid volumes up to 20,000 brls. per day are being successfully handled by gas-lift, whilst casing pumps handle wells economically which are making as much as 99% water.

The present daily salt-water production from 340 wells is approximately 1,000,000 brls.

To cope with this one company dug and put into operation a large drainage ditch 20 to 25 ft. wide running down through the centre of the entire field. The ditch has a rated capacity of 1,000,000 brls. per day.

Abandonment rate in the field has been almost checked now that operators have realized that large fluid volumes can be profitably handled by gas-lift and casing pumps. L. V. W. C.

977. Experiments on Fluid Capacity Plugging of Oil-Well Screens. R. L. Chenault. *Oil Gas J.*, 9.6.38, **37** (4), 54.—A series of tests have been carried out on fluid capacities and plugging of oil-well screens to determine the relative merits of various types of screens in common use.

The experiments carried out and the apparatus used are fully described.

L. V. W. C.

978. Shot-Hole Recorder Measures Width of Cavity in Well. R. B. Bossler. *Oil Gas J.*, 30.6.38, **37** (7), 44.—A knowledge of the shape and size of a shot hole and the position of cavities is of importance in secondary recovery work, particularly when packers are to be set. A device has been developed which will give a good idea of the line of the wall of the well.

The apparatus, which is described fully, is electrically operated and has spring-actuated fingers which follow the contour of the hole, operating, through a linkage, a variable resistance in the circuit. The variation in the current flowing resulting from a variation of the resistance is indicated on an ammeter. L. V. W. C.

Transport and Storage.

979. Determining Location and Capacity of Units for Cathodic Protection of Pipe-Lines. S. O. McGary. *Petrol. Engr*, July 1938, **9** (11), 40.—For mechanically coupled

lines, each coupling should be bridged with a thick copper wire to provide a continuous path before testing for the amount of electrical energy required for protection. Testing is effected by installing a temporary ground-bed of junk pipe in a shallow trench, and first testing the potentials of the portion of line to be protected. Power is then supplied from a portable source at a constant rate and the potentials are again measured, the area between the curves representing the potential change in the section due to the applied electrical drain.

With welded or screw-coupled lines, insulation of the section to be tested with a temporary flange is impracticable, so that electrical blocking is used. This consists of installing small units at each end of the section, the current being supplied from a storage battery or car generator and using ground-beds about 10 ft. from the line. A large generating-station of 50 amps. capacity at 50 volts, if the line is bare, is installed in an intermediate position with a ground-bed at least 400 ft. from the line.

The blocking units are started and regulated so as to drain 5 or 6 amps. from the line, and the testing unit is started and regulated so as to produce a potential on the line between the two ends. The points of reversal are found by current measurements on the pipe-line, these having the same effect electrically as an insulating coupling. The distance between these points then represents the amount of line the potential of which has been changed by the current flow from the testing-station. The amount of pipe protected is estimated as in the case of the mechanically coupled lines. The wastage of current at the point where the ground-bed is attached to the pipe-line can be reduced by using two split ground-beds, giving better distribution of electrical energy. The quantity of current which must be drained from a pipe-line in order to protect a certain section is affected by the type and condition of the coating, by the soil contact at bare places, by the resistance of the soil, and by the presence of air-gaps between paper wrappings and the pipe and, probably, by a number of other undetermined factors. C. L. G.

980. Use of Small Units for Electrical Protection of Pipe-Lines. S. Thayer. *Petrol. Engr*, July 1938, **9** (11), 42.—If a large cathodic unit is used to protect a line, it is necessary to have a large excess of current in the area near the station, in order to ensure adequate current at the ends of the section. A large number of smaller units will accordingly result in a saving of power. An example is given of a large unit using 800 watts to protect a mile of pipe where the same protection could be afforded by four units taking 48 watts. The minimum size is, however, limited by the difficulty of obtaining and operating satisfactory engines smaller and cheaper than those at present in use. Where rectifiers are used and where power can be obtained at short intervals along the line, an obvious saving is indicated. The heat generator now being offered by one manufacturer provides a possible method of supplying the smaller units. C. L. G.

981. Distribution of Propane Gas by Pipe-Line. P. le Goupils and R. Walter. *Chaleur et Industrie*, 1938, **19**, 92–101.—Where coal-gas has not yet penetrated, it is claimed there is a good potential market in France for liquefied propane. If in the absence of a local refinery or gas works the gaseous fuel has to be transported, liquefied petroleum gas has a considerable advantage over coal-gas. For instance, to transport 600 gm. of coal-gas necessitates the transport, including return of empties, of a total weight of 13,000 gm., whereas 1000 gm. of propane requires the total transport of only 2800 gm.

The article proceeds to describe the manufacture of propane gas and its many advantages, and then outlines its use as a community gas supply from containers with capacities of about 1000 kg. of propane. Recently rail containers holding 13,000 kg. of propane have made their appearance, and are utilized for charging the smaller containers. The technique of distributing installations and pipe-line construction is given, being based mainly on installations giving very satisfactory service at Languyon and Vologers. Photographs illustrate installations and containers.

The authors are not in favour of the distribution of propane/air mixtures.

T. C. G. T.

982. Method of Calculating Oil Evaporation Losses. Parts 1 and 2. W. F. Rogers. *Petrol. Engr*, June 1938, **9** (9), 39; July 1938, **9** (11), 48.—Evaporation loss of crude

oil from storage-tanks can be determined, by gauging, from the change in specific gravity of the oil or from the change in vapour pressure. Gauging is applicable only to oils in storage, and frequently gives erroneous results owing to the difficulty of determining the average temperature. The change in specific gravity can be easily determined for oils in storage or in transit, providing no contamination has taken place and that truly representative samples can be obtained. The vapour-pressure change is a useful method for gasolines in storage, giving a straight line when plotted on semi-log paper against the percentage distilled, but for crude oils a straight line is not obtained. For oils in transport the latter two methods are open to error owing to unavoidable contamination.

A method of calculating the storage losses of crude oils from the change in vapour pressure has been evolved which shows the general trend of the loss values and is applicable to a wide variety of crude oils under different conditions of storage. The formula for evaporation loss is given as: Gals. gasoline lost per year

$$= \left[\left(V \times \frac{460 + t_2}{460 + t_1}\right) - V + \frac{VdpC}{760}\right] \text{gal. per } M \times \frac{365C}{1000},$$

where V = volume of vapour space in cu. ft., t_1 = minimum daily temp. in ° F., t_2 = maximum daily temp. in ° F., dp = daily vapour pressure variation in mm. of mercury, and C is a correction factor, the fraction of equilibrium which the hydrocarbon vapours are able to obtain by virtue of insufficient time to obtain complete equilibrium between periods of breathing. (Values tabulated for different heights of oil to tank roof.) Gal. per M is the number of gals. of gasoline in 1000 cu. ft. of the vapour breathed.

From studies in the field determinations have been made of the daily temperature cycle of tank vapours and of the oil surface, the volume of tank vapour space, vapour-pressure curves for W. Texas crude oil and the gasoline content of vapours.

From this formula typical calculations are made of the gasoline lost per annum, the length of time required for the vapour pressure to fall to a specified figure, the evaporation loss of a range of crude oils and the average loss in shipping 80,000 brls. of E. Texas oil through three pipe-line stations.

Calculated data on breathing losses are compared with data published by the J. H. Wiggins Co. and the Chicago Bridge and Iron Company. The calculated data were generally higher than the actual, probably owing to the inability to transfer the maximum vapour temperature to the gasoline surface while the temperature cycle for the day in question had to be assumed.

It is felt that the method described cannot be used for short-time tests unless the temperatures are measured, as these may differ radically from the monthly averages, but is adequate for oil held in storage for one year in the U.S. Other approximations result in a higher figure than the true being obtained, but the results indicate the importance of limiting the vapour space in the tank. C. L. G.

Gas.

983. Butane and Propane for Domestic and Industrial Heating. J. Lefrancq. *Chaleur et Industrie*, 1938, **19**, 167–177.—Liquefied butane and propane appeared on the French market in 1932. The article is a comprehensive but concise review of the application of these gases, particularly in France.

In France the composition of commercial propane is: propane and propylene 96–97%, ethane and ethylene 1–4%, and *iso*butane and *iso*butylene up to 2%. Commercial butane is: butane and butylenes 70–78%, *iso*butane and *iso*butylene 20–25%, propane and propylene 1·5–5%, and pentanes and amylenes up to 0·5%.

The containers are filled to a specified weight of liquid per unit volume; for butane this is 0·520, for *iso*butane 0·488, and for propane 0·425. These containers are tested at 50° C., at which temperature commercial butane exerts a pressure of 4·5 kgm. per sq. cm., and propane 18 kgm. per sq. cm. Although a satisfactory safety margin against rupture of containers would be 50% above the 50° C. test, the official recommendation is for butane containers 10 kgm. per sq. cm. and for propane 30 kgm. per sq. cm. Specifications for cylinders are given and the analysis of a typical steel is recorded. Butane cylinders are tested at 30 kgm./sq. cm. and propane cylinders at 45 kgm./sq. cm. Actually, when the rest of the specification is met, rupture of the

cylinders does not occur until 45 kgm. with the butane type, and 70 kgm. with the propane type.

The distribution of the gases is briefly outlined and the combustion of the hydrocarbons is dealt with at some length. T. C. G. T.

984. Utilization of Petroleum Gases. A. E. Dunstan. *Rev. Pétrolif.*, 24.6.38 (791), 832–833.—The first of three lectures held at the "Semaine de Perfectionnement" (June 13–20, 1938) at the Ecole du Petrole, Strasbourg, was concerned with the various processes of pyrolysis and polymerization of petroleum gases, and the author pointed out that the present trend of research is towards the development of a process of continuous conversion of methane into petrol. As a method of the greatest importance the dehydrogenation without cracking of propane and butane into the respective olefines was mentioned, enabling compounds such as *iso*propyl ether and *iso*-octane to be finally obtained.

The second lecture dealt with the condensation of olefines with *iso*paraffins, among which the direct combination of *iso*butane with *iso*butene at normal temperatures in the presence of H_2SO_4 (97%) is of particular interest for its easiness of reaction and the high yield of high-octane *iso*paraffins. In this process the olefines are introduced into a vessel containing the *iso*paraffin + H_2SO_4, under continuous agitation, and, with the temperature maintained constant at 20° C., the condensation process is completed after 90 mins., with the pressure gradually falling from initially 45–50 lb./sq. in. to atmospheric. After distilling off the fraction 27–185° C. a residue remains of 15%. The reaction can be applied generally to a great number of olefines and *iso*paraffins. Data of analysis are presented on products thus obtained from various combinations of paraffins (prevalent *iso*butane) and olefines (including the product of condensation of butene and *iso*butene), giving also octane numbers with and without lead.

The third lecture comprised a survey of the future of the petroleum industry, indicating the rôle played by modern technology in oil conservation, and the ever-increasing varieties of petroleum products with an almost unlimited field of use.
L. R.

985. Study of Gas-Pressure-Regulating Valves. A. Pignot. *Chaleur et Industrie*, 1938, **19**, 102–107.—The demand of the bottled gas consumer for reducing valves that are consistently accurate is stressed, and the problem of producing a reliable valve discussed. The construction of the diaphragm membrane receives much attention. Experiments have been carried out which appear to indicate that leather is the most suitable material. T. C. G. T.

986. Compressed Gas Cylinders. A. Pignot. *Chaleur et Industrie*, 1938, **19**, 85–91.—A survey of the steel and alloy cylinders in use, their construction, composition, and the tests applied to them in determining their safety limits. T. C. G. T.

987. General Properties of Burners for Use with Gaseous Combustibles. E. Biard. *Chaleur et Industrie*, 1938, **19**, 108–113.—An attempt has been made to develop logical calculations expressing the effect of various factors on the burning of gas. Whilst admitting that the calculations are not perfect, the author claims that they do offer some assistance in the problems of design and operation of gas burners.
T. C. G. T.

988. Patents on Gas. Ruhrchemie A.-G. E.P. 486,928, 9.6.38. Catalytic conversion of CO into higher hydrocarbons by means of H_2 using Co, Ni and Fe as catalysts containing Mg and Th as activators. The non-volatile reaction products formed which settle in the catalyst, are removed from it by the action of H_2 or the use of solvents, revivification being effected under increased pressure in the synthesis furnace.

G. W. Johnson. E.P. 486,980, 14.6.38. Apparatus for the separation of gaseous mixtures into their components. W. S. E. C.

Cracking.

989. Patents on Cracking. R. W. Coghill. U.S.P. 2,121,537, 21.6.38. Improved furnace for tube still. W. S. E. C.

Hydrogenation.

990. Patents on Hydrogenation. Gewerkschaft Auguste. E.P. 487,250, 17.6.38. Hydrogenation of mixtures of hydrocarbons formed from methane and oxides of carbon.

H. E. Potts. E.P. 486,994, 14.6.38. Hydrogenation of heavy hydrocarbon materials to produce gasoline in two stages using as catalyst a sulphide of a heavy metal of group 6 of the periodic system supported by a carrier.

M. Pier and W. Simon. U.S.P. 2,119,647, 7.6.38. Hydrogenation of carbonaceous substances to produce motor spirit. The catalyst used is selected from the group consisting of Mo, Fe, Ni, Co and compounds of these metals with an alkaline reacting substance in amounts of 0·1–1·5% calculated on the initial material, together with 0·1–5% of a substance from the group consisting of halogens, acids and substances furnishing a halogen or an acid under working conditions.

M. Pier and E. Donath. U.S.P. 2,120,295, 14.6.38. Destructive hydrogenation of carbonaceous substances at 300–600° C. and at $>$ 20 atm. pressures, using a solid catalyst. An undesired increase in temperature above the working temperature is eliminated by adding ammonia to the reaction space.

J. D. Seguy. U.S.P. 2,120,715, 14.6.38. Destructive hydrogenation of heavy hydrocarbon material in two stages to produce gasoline. W. S. E. C.

See also Abstracts Nos. 1023, 1024 and 1025.

Polymerization.

991. Patents on Polymerization. N.V. de Bathaafsche Petroleum Mij. E.P. 487,166, 15.6.38. Acid polymerization of *iso*butylene using aqueous H_2SO_4 containing 3–10% H_2SO_4 by wt.

R. C. Osterstrom and C. R. Wagner. U.S.P. 2,121,258, 21.6.38. Polymerization of cracked hydrocarbon gases. W. S. E. C.

Refining and Refinery Plant.

992. Recent Progress in the Chemical and Physical Refining of Petroleum Products. Part 1, Purification of Gas. B. Kwal. *Petrol. Engr*, July 1938, **9** (11), 33.—A discussion is presented of the reactions involved in and the operating details of a variety of methods for the removal of hydrogen sulphide from gas. These include the use of (*a*) iron oxide, which is dangerous owing to the heat evolved, and uneconomic, owing to the excessively large contactors and regenerators required; (*b*) a suspension of iron hydroxide in water which requires expensive equipment and power cost and a large volume of air for oxidation of the spent material; (*c*) soda-ash solution (Seabord process) and similar reagents, including the weaker bases and alkali salts of strong bases and weak acids and the strong bases. These present difficulties with high concentrations of H_2S and in the presence of CO_2, owing to reaction with the absorbents used; (*d*) aliphatic amines (Girbotol process) which are suitable for gases containing high percentages of H_2S; (*e*) water followed by the addition of SO_2 to form free sulphur which is flocculated by the addition of certain electrolytes. This method, proposed by Leahy, is an economical method requiring no heating or cooling and no air for regeneration, whilst no H_2S is released to the atmosphere. Kuhl gives a variation in which the gas is mixed with NH_3 or SO_2 and passed into water; (*f*) sodium phenolate solution, which has the advantage of using cheap chemicals; (*g*) sodium or ammonium thio-arsenate (Thylox process); (*h*) an aqueous solution or suspension of a metal oxide, hydroxide or carbonate, free sulphur being recovered from the spent solution by oxidation, simultaneously regenerating the solution. C. L. G.

993. Evaluating Oil Stocks by Gravity Curves. W. L. Nelson. *Oil Gas J.*, 7.7.38, **37** (8), 46.—The designer of refinery equipment can seldom obtain exact physical properties of the stocks which he must produce, and has frequently resorted to averaging and the use of property curves. The two common types of curves known as "mid-percent" and "yield" curves, respectively, have been checked against one another by examination of a series of fractions obtained by a true b. pt. distillation of a benzene type stock extending through gasoline and kerosine. A table shows the percentage range of the cuts and the experimental A.P.I. gravity. The method of construction of the mid-percent curve relating A.P.I. gravity to percentage distilled is described.

Gravities of various wide-boiling-range fractions as determined with the aid of the curve were checked by actual determinations on blends of the original fractions obtained on distillation. The agreement seems to be within the experimental accuracy of the laboratory procedure used. The greatest inaccuracies (about 0·7% A.P.I.) are in those blends involving the lightest fractions, and are probably due to losses in mixing. Greater accuracy may be attained by the use of sp. gr. rather than A.P.I. gravity.

Yield curves differ from mid-percent curves because they tell the total percentage of a wide fraction of given gravity that can be produced. From the experimental data, yield curves relating gravity of distillate to yield of distillates starting from 0%, 20% and 30% of distillate and also gravity of residue to yield of residue were drawn. Points determined by plotting the computed gravities are shown.

The degree of agreement is sufficient to warrant the conclusion that the mid-percent curve can be computed from yield curves and vice-versa with reasonable accuracy. R. A. E.

994. Cold Acid Treatment of Cracked Naphtha. C. W. Stratford, F. G. Graves and E. S. Brown. *Refiner*, March 1938, **17** (3), 109.—The article considers the desiderata of the treatment, for purposes of desulphurization, gum and colour stabilization, of cracked distillates with sulphuric acid under accurately controlled conditions of relatively low temperature and contact time. Economy of acid required and reduced losses of product are claimed. No hard-and-fast rules are laid down, and every different charging stock has to be treated under conditions specified as the result of small-scale experimental work. H. G.

995. Chlorination of Cooling Waters. N. C. Estes. *Refiner*, May 1938, **17** (5), 191.—The prevention or curtailment of heat-transfer losses through the elimination or control of slime formation in heat-exchange units has been effected successfully by chlorinating the cooling water. A comprehensive biological and chemical survey of the slime and scale deposits is a prelude to the installation of the necessary chlorine-feed control devices at the proper points. All heat-exchange deposits are at least partly organic in nature, and have their origin in algæ and bacteria. All waters have a specific "chlorine demand," requiring, for the oxidation of organic contaminants, a certain minimum amount of chlorine which must be exceeded before the requisite "chlorine-residual" is available for the control of organisms. Treatment may be continuous, in recirculatory systems, or intermittent where the cooling water is discharged to waste. In the latter case chlorine is used, in the interest of economy, only for the removal of slime when it has formed in sensible quantity. H. G.

Chemistry and Physics of Petroleum.

996. Modern Commercial Acid-Treating Reproduced in Laboratory. F. Sager. *Refiner*, Feb. 1938, **17** (1), 57.—An account is given of a new continuous laboratory apparatus which has been assembled for purposes of development work on the Separator–Nobel (S-N) treating process for cracked distillates, etc. It allows of the determination of the optimal plant conditions and exact chemico-technical and economical comparisons of the following processes: (*a*) single-stage treating with centrifugal separation; (*b*) single-stage treating with gravity settling; (*c*) two-stage counter-current treatment with gravity settling in the first (spent acid) stage and centrifugal separation in the second (fresh acid) stage; (*d*) two-stage counter-current treatment with centrifugal separation in both stages. The capacity of the plant is 15 gals. per hour. H. G.

997. Practical Thermodynamic Chart for Hydrocarbons. J. E. Hedrick. *Refiner*, April 1938, **17** (4), 140.—The free energy, ΔF, of any reaction is a measure of that reaction to occur. In the case of free energy of formation it becomes a measure of the ability of the compound to be formed from the elements. If ΔF is negative, then the compound is stable and the reaction proceeds to a usable extent. It does not supply evidence of the reaction rate, which can be altered by the working conditions or the nature of a catalyst. The great number of recent determinations of heats of combustion and specific heats at low temperature has made possible the accurate tabulation of a considerable amount of free-energy data. Some of the data have been recorded in the form of charts in which ΔF of formation in B.Th.U. per lb. is plotted against the number of C atoms in the molecule. Two such charts are published. H. G.

998. Separation of Olefins and Aromatics from Hydrocarbon Mixtures. J. W. Wells and J. E. Hedrick. *Refiner*, March 1938, **17** (3), 95.—Using synthetic mixtures of known proportions of pure hydrocarbons, the existing methods for the estimation of unsaturated hydrocarbons have been investigated. The method of Faragher, Morrell and Levine was found to be the only reliable method. In this, olefins and some aromatics are removed with 90–92% H_2SO_4, with subsequent distillation to remove polymers. The remaining aromatics are then removed with 98% H_2SO_4, and the total volume loss is taken as the sum of olefins and aromatics. Olefins are removed from a fresh sample with sulphur monochloride and the aromatic content of the olefin-free mixture is determined by a nitration method. H. G.

999. Synthesis of High-Molecular Paraffins. H. Pichler, *BrennstChemie*, 15.6.38, **19** (12), 226–230.—The paper presents data on tests carried out to develop a method of synthesis of very high-melting paraffins, and also to find a suitable catalyzator. To obtain higher hydrocarbons by synthesis of CO and H at high temperatures and pressures, ruthenium is the best of all known catalyzators (including cobalt, nickel and iron), and the most favourable conditions for the reaction were found to be 100 at. pressure and a temperature just below 200° C. The reaction proceeds according to the equation: $xCO + 2xH_2 + xCH_2 + xH_2O$.

A long-duration test was carried out under uniform conditions (100 at., 195° C.) for 26 weeks. The quantity of gas introduced during 1 hr. was approximately 1·1 lit. on an average, and gas contraction amounted to about 70%. No variations were observed with the reaction during the half-year's period, although the contact substance was not regenerated, and output remained constant at 140–145 gm. solid + fluid hydrocarbons for one normal cubic metre of gas (containing 33·3% CO and 66·7% H at 0° C.).

The resultant solid synthetic product (about 100 gm./m.³) liberated by butanone of fluid constituents, was of white appearance and had a final melting point of 118–119° C. Boiling toluol was necessary to get the product off the catalyzator, and, owing to its limited solubility, fractions could be isolated only with great difficulty. Hitherto unknown paraffins of very high melting point were isolated and examined. With a mean molecular weight range from 2100 to 8000, corresponding to saturated paraffins of the formula $C_{300}H_{402}$ to $C_{800}H_{1202}$, their melting points varied from 123·5° to 131·5° C.

The addition of diatomite to the catalyzator (1 : 1) had no influence on the reaction. L. R.

1000. High-Octane Gasoline Obtained by Catalytic Dehydrogenation. V. I. Karzhev, M. G. Sever'Yanova and A. N. Siova. *Oil Gas J.*, 9.6.38, **37** (4), 50.—Continuing the investigation of catalysts for dehydrogenation and isomerization of organic compounds, a study has been made of the dehydrogenation of tetralin and decalin, using chromium catalysts, and the possibility of converting paraffin hydrocarbons into aromatics using normal decane, *iso*decane, normal heptane and a fraction of Grozny aviation gasoline from which aromatics had been removed. Reaction temperatures ranged from 500° C. to 550° C., and in the case of the Grozny aviation three passes were made. Chromium–molybdenum oxide, and especially chromium–copper–phosphoric acid catalysts, were found to be most active. Using the latter a catalyzate from the Grozny aviation containing 32·2% of aromatic hydrocarbons was obtained, with considerable

decrease in the paraffin hydrocarbon concentration. Similar results were obtained with *n*-heptane. With *n*-decane a 70% yield of a product, distilling mainly up to 120° C. and containing 44·8% aromatics, was obtained. *iso*Decane yielded a product containing 18% of aromatics. The experiments showed the existence of a reaction according to which paraffin hydrocarbons undergo a ring closure and a simultaneous dehydrogenation, which is interesting as a possible application for increasing the octane number of motor fuels. Possible schemes according to which the reactions take place are illustrated.

When tetralin and decalin are passed over the catalysts mentioned, the reactions which take place are not dehydrogenation reactions alone, but also those connected with the rupture of the ring. For example, tetralin passed over the least active catalyst of the group, chromium–phosphoric acid, at 550° C. yielded a product containing 5% of xylene, and decalin under similar conditions yielded 70% of a product containing only 8% naphthalene and a high concentration of toluene and xylene in the fraction distilling up to 150° C. With the more active catalysts a conversion of 35% of the decalin was obtained at 550° C., the catalyzate, on the basis of converted decalin, containing 59% of low-boiling aromatics. The gas analyses indicate that in the case of dehydrogenation, the gas obtained is nearly 100% hydrogen, but when ring rupture takes place as well, the hydrogen content decreases and unsaturated hydrocarbons appear in appreciable quantities. Small amounts of paraffin hydrocarbons may also appear in the catalyzate. Possible reaction schemes are illustrated.

R. A. E.

1001. Hydrogen from Methane. Catalytic Conversion with Steam. Anon. *Chem. Trade J.*, 24.6.38, **102**, 530.—At a recent general meeting of German chemists, Dr. Schiller discussed methods for production of hydrogen from hydrocarbons. The old process for direct splitting of methane into carbon and hydrogen is not considered for new plants, as the carbon black is not of specially good quality and the hydrogen requires much purification. Non-catalytic discontinuous method of decomposition with steam is of limited application, and usually employed in ammonia synthesis. The catalytic processes for conversion of hydrocarbons with steam first received practical application when improvements in the catalysts (activated nickel) allowed operation at temperatures of 600–800° C., and enabled use of industrial hydrocarbon gases without danger of formation of carbon black. Works' experience has demonstrated the permanence of the special steels and of the activated catalyst, but removal of H_2S and of organic sulphur compounds from the gases before conversion is essential. Residual methane in the gas produced (1·5–2%) can be removed, where necessary, by low-temperature cooling or further decomposition by air or oxygen. The last-mentioned reaction can also be employed for direct production of hydrogen from methane, but economically does not compare favourably with the steam catalytic method described. Dr. Wilke stated that the "synthesis gas" used for gasoline production by the Fischer–Tropsch process, as modified by the Ruhrchemie Company, should contain less than 0·2 gm. per 100 cu. m. of organic sulphur and of H_2S. Organic sulphur is removed by a catalytic process employing alkalized iron oxide, whereby it is converted into H_2S at temperatures between 200° C. and 300° C. H_2S is removed in the usual way.

R. A. E.

1002. Chemical Trends in the Petroleum Industry. K. Frolich. *Industr. Engng Chem.*, 1938, **30** (8), 916.—The more recent advances in petroleum chemistry are reviewed under the following headings: (1) Development of Motor Fuels, (2) Lubricating Oil Production, and (3) Chemical Utilization of Petroleum Products.

(1) *Development of Motor Fuels.*—The relationship between chemical structure and octane number is discussed. The earliest method for increasing the proportion of high-octane structures was the cracking process. This was followed by the introduction of destructive hydrogenation, which increased the yield of high-octane spirit obtainable from a given stock, as well as being an improvement over thermal cracking in other respects. The latest phase in the development of motor fuels is the production of synthetic fuels. Under this heading the reactions involved in the preparation of *iso*-octane from *iso*butylene are given. It is observed that high-octane fuels may be prepared by: (*a*) the condensation of *iso*butylene with other olefins followed by hydrogenation, (*b*) the direct addition of olefins to paraffins with the aid of a modified

Friedel and Crafts catalyst, and (*c*) the cyclization of normal paraffins under dehydrogenating conditions in the presence of a metallic oxide catalyst.

(2) *Lubricating Oil Production.*—Brief references are made to : (*a*) the relationship between chemical constitution and viscosity index, and (*b*) the raising of the viscosity index by hydrogenation, solvent refining, or the addition of certain high molecular weight straight chain polymers.

(3) *Chemical Utilization of Petroleum Products.*—The preparation of certain solvents may be accomplished by the careful fractionation of petroleum distillates. Naphthenic acids, mercaptans, nitrogen bases and alkyl phenols are now removed from petroleum and marketed. High-molecular-weight fatty acids may be produced by the low-temperature catalytic oxidation of paraffin wax, and dibasic acids by the catalytic vapour phase oxidation of unsaturated straight-chain hydrocarbons. Controlled chlorination has yielded a number of valuable solvents. In the resins and plastics field a great variety of different materials are now produced. Information regarding the composition of twelve of the commercially available resins and plastics is given.

J. W. H.

1003. Action of Aluminium Chloride on *cyclo*Hexylbenzene. B. B. Corson and V. N. Ipatieff. *J. Amer. chem. Soc.*, 1938, **60**, 747–749.—*cyclo*Hexylbenzene yields a number of products when it is heated at 80–85° C. with aluminium chloride. The main products are di*cyclo*hexylbenzene, benzene, diphenyl*cyclo*hexane and *cyclo*hexane ; this indicates that the following reactions occur :—

$$2C_6H_{11}C_6H_5 \longrightarrow C_6H_{11}C_6H_4C_6H_{11} + C_6H_6.$$
$$2C_6H_{11}C_6H_5 \longrightarrow C_6H_5C_6H_{10}C_6H_5 + C_6H_{12}.$$

At the same time some hexane is formed, presumably from the opening and hydrogenation of *cyclo*hexane.

The two phenyl groups in the diphenyl*cyclo*hexane were in the 1 : 4 position, as were the *cyclo*hexyl groups in the di*cyclo*hexylbenzene.

The highest-boiling fraction from the original reaction product contained a material the composition of which corresponded to $C_{24}H_{30}$, a combination of two phenyl groups and two *cyclo*hexyl groups.

W. E. J. B.

1004. Nitrogen Compounds in Petroleum Distillates. XI. Isolation of 2 : 3-Dimethyl-8-Ethylquinoline from the Kerosine Distillate of California Petroleum. C. L. Key and J. R. Bailey. *J. Amer. chem. Soc.*, **60**, 763–765.—The crude bases used in this investigation were derived from the residual sulphur-dioxide extract obtained in refining kerosine by the Edeleanu process. The kerosine distillate was derived from California asphalt base petroleum.

The paper describes the isolation of 2 : 3-dimethyl-8-ethylquinoline, the structure of which has been confirmed by synthesis.

By indirect dealkylation of the above base there were obtained 2 : 3-dimethylquinoline and 3-methyl-8-ethylquinoline. The former is one of the five quinolines previously isolated from a kerosine distillate, whilst the structure of the latter, a new quinoline homolgue, has been established by synthesis.

W. E. J. B.

1005. Mutual Solubilities of Hydrocarbons. II. Freezing-Point Curves of Dotriacontane (Dicetyl) in Dodecane, Decane, Octane, Hexane, *cyclo*Hexane and Benzene. W. F. Seyer. *J. Amer. chem. Soc.*, **60**, 827–830.—This paper gives freezing-point data of six separate systems of dicetyl with some low-molecular-weight hydrocarbons. The latter were dodecane, decane, octane, hexane, *cyclo*hexane and benzene.

From the freezing-point curves obtained it appears that after a concentration of about 0·4*N* is reached, the solute exerts its influence in determining the shape of the freezing-point curve, and it is suggested that this may be due to a separation of mixed crystals from the solution.

The data support the validity of Raoult's law.

W. E. J. B.

1006. Thermal Decomposition of Alicyclic Compounds. I. Decomposition of *cyclo*Hexene and Some Simpler Hydrocarbons. F. O. Rice, P. M. Ruoff and E. L. Rodowskas. *J. Amer. chem. Soc.*, 1938, **60**, 955–961.—The authors have found that *cyclo*hexene

can be decomposed almost quantitatively into 1 : 3-butadiene and ethylene by heating at about 10 mm. pressure and 800° C. Under these conditions the rates of decomposition of the ethylene and butadiene are negligible in comparison with that of the *cyclo*hexene.

A test for free radicals showed that the rate of recovery of metallic mirrors by the fragments from *cyclo*hexene is of a lower order when compared with the rate of recovery by open-chain compounds such as acetone, which is known to decompose into free radicals. Any free radicals formed in the reaction must be present to a small extent.

It is assumed that the primary step in the reaction consists of the fracture of a C–C bond in the β position to the double bond, followed by decomposition into ethylene and butadiene. W. E. J. B.

1007. Phosphoric Acid as Catalyst in the Ethylation of Phenol. V. N. Ipatieff, H. Pines and L. Schmerling. *J. Amer. chem. Soc.*, 1938, **60**, 1161–1162.—Ethylene reacts readily with phenol in the presence of phosphoric acid at 200° C., yielding *o*- and *p*-ethylphenol, diethylphenol and higher ethylated phenols, as well as phenetole, *o*- and *p*-ethylphenetole, and higher ethylated phenetoles.

The use of *cyclo*hexane as solvent for the reaction results in a higher yield of alkali-soluble product at the expense of the alkali-insoluble material.

Propene reacts with phenetole in the presence of phosphoric acid, yielding nuclear alkylated products. The results indicate that the formation of an ether is not a necessary intermediate step in the C-alkylation of phenols.

W. E. J. B.

1008. Induced Liquid-Phase Decomposition of Hydrocarbons. P. L. Cramer. *J. Amer. chem. Soc.*, 1938, **60**, 1406–1410.—A study has been made of the induced liquid phase decomposition of a number of paraffinic, olefinic, aromatic and hydroaromatic hydrocarbons as initiated by the thermal decomposition products of tetra-ethyl lead.

The experiments were carried out in a bomb at reaction temperatures at 200–300° C. The course of the reaction was followed by a complete analysis of the gaseous reaction products, and in certain cases the oily liquid reaction products were examined.

With the exception of the aromatic hydrocarbons, induced reactions occurred with all of the hydrocarbons, the type and the extent of the reactions apparently depending on both the class and the molecular structure of the hydrocarbon.

Evidence has been presented in support of the assumptions that the induced reactions are initiated by free ethyl radicals, and also that the influence of the class and the molecular structure of the hydrocarbon on the reactions may be determined by the relative amounts and reactivities of the primary, secondary and tertiary hydrogen atoms in the molecule.

Certain analogies between the reaction data and certain data on the stability, the oxidation and the knocking characteristics of the paraffins from the standpoint of chain mechanisms involving free radicals have been pointed out. W. E. J. B.

1009. Condensation of Aliphatic Alcohols with Aromatic Hydrocarbons. I. Preparation of Mesitylene and *sym*-Triethylbenzene. J. F. Norris and J. N. Ingraham. *J. Amer. chem. Soc.*, 1938, **60**, 1421–1423.—Methods are described for the preparation of mesitylene by condensing methyl alcohol with toluene or *m*-xylene in the presence of aluminium chloride and for the preparation of symmetrical triethylbenzene from ethyl alcohol and benzene. W. E. J. B.

1010. Identification of Alkylbenzenes. II. Identification of the Eight Amylbenzenes and *cyclo*Pentylbenzene by Means of Their Mono- and Di-Acetamino and Monobenzamino Derivatives. V. N. Ipatieff and L. Schmerling. *J. Amer. chem. Soc.*, 1938, **60**, 1476–1479.—The eight amylbenzenes and *cyclo*pentylbenzene have been characterized by the preparation of their mono- and di-acetamino- and monobenzamino-derivatives. All three derivatives may be obtained from a single nitration product. W. E. J. B.

1011. Thermal Data on Organic Compounds. XVIII. Heat Capacity and Entropy of *tert.*-Butylethylene. W. D. Kennedy, C. H. Shomate and G. S. Parks. *J. Amer. chem. Soc.*, 1938, **60**, 1507–1509.—The authors have measured the heat capacities of *tert.*-butylethylene between 80° and 298° K., and from this data they have estimated the molal entropy of liquid *tert.*-butylethylene at 298° K. This figure is 61·3 cals. per degree. It should be noted that the compound exists in two crystalline forms at low temperatures, with a transition point at 124·9° K.

With the data available, the free energy of the dehydrogenation of 2 : 2-dimethylbutane has been calculated, and the value obtained for $\Delta F_{298^\circ C.}$ of 21,700 ($\pm$ 500) cals. This figure is in good agreement with the figure recently obtained for several other cases involving the dehydrogenation of paraffins to yield mono-substituted ethylenes. W. E. J. B.

1012. Speed of Propagation of a Flame in a Homogeneous Combustible Mixture Under Constant Pressure—Theory of the Blue Cone. M. Ribaud. *Chaleur et Industrie*, 1938, **19**, 23–27.—Much of the article is devoted to an appeal for an improved nomenclature in the subject, and several commonly used phrases are criticized. Alternatives are offered; thus, for "speed of propagation of the flame," the author suggests "speed of deflagration." Many phrases are claimed to be ambiguous.

Speed of deflagration is defined. Gouy's blue-cone theory is discussed and its application, with certain modifications, to the determination of the speed of deflagration is outlined. T. C. G. T.

1013. Theory of Speed of Flame Propagation. M. Ribaud. *Chaleur et Industrie*, 1938, **19**, 28–32. A study of the theory of physical mechanism of flame propagation and the factors affecting it, followed by a summary of conclusions. The author is very doubtful if one can predict propagation speeds in mixtures. T. C. G. T.

1014. Speed of Propagation of Combustion—The Uniform Movement of the Flame. P. Laffitte. *Chaleur et Industrie*, 1938, **19**, 33–37.—Recent developments are analysed and discussed. T. C. G. T.

1015. Researches Upon the Identification of Chemical Reactions Occurring in Flames. M. Prettre. *Chaleur et Industrie*, 1938, **19**, 38–43.—The most notable works on the subject are surveyed and discussed. T. C. G. T.

See also Abstract No. 984.

Analysis and Testing.

1016. Viscosity Measurement. M. R. Cannon and M. R. Fenske. *Industr. Engng Chem. Anal.*, 1938, **10** (6), 297–301.—Three types of modified Ostwald viscometers are described: (1) a routine viscometer for petroleum products as described by the A.S.T.M.; (2) a viscometer for non-viscous liquids covering the range 0·3–5 centistokes; (3) a semimicro-viscometer requiring a charge of 0·25 c.c. and covering the range 0·5–800 centistokes. Types (1) and (3) are made with capillaries of different diameters in order to extend their useful range.

Magnitudes and sources of various possible errors are investigated, and equations are quoted for correcting errors due to kinetic energy effects, to surface-tension effects, to incorrect alignment of the viscometer with respect to the vertical, and to variation of viscometer constant with temperature. Errors due to variations in g are also considered.

The possibility of absorption of radiant energy from the light source used to illuminate the viscometer is investigated, and it is shown that, in the case of a dark oil, this may cause the oil temperature to rise 0·5° C. above the temperature of the water in the bath. This source of error is, however, easily removed by taking the simple precaution of not having the light too near the thermostat.

The authors claim that under ordinary careful conditions of use, these viscometers are equal in accuracy to any capillary viscometer in use, and give a reproducibility of results within $\pm$ 0·2%. T. T. D.

1017. Ostwald-Fenske Viscometer. G. F. Fitzgerald. *Refiner*, Feb. 1938, **17** (2), 86.—The introduction of the viscosity index has emphasized the faults inherent to the Saybolt instrument and has made necessary the use of a viscometer permitting greater accuracy in determinations. Methods and apparatus for the measurement of kinematic viscosity have been developed to the point where they may be used for control work. The Fenske modification of the Ostwald viscometer is an example of such apparatus. It is notable for its simplicity, ease of manipulation and high order of reproducibility. The ability to base viscosity-index values on a fundamental basis rather than on empirical units is a great advantage. H. G.

1018. Modification of Conradson Coke Test. K. Schröder. *Oel u. Kohle*, 1938, **14**, 396.—A method proposed by the Swedish Standardization Commission is described. The crucible is heated electrically and its temperature during burning of the oil is restricted to 440–550° C. (approx.).

Results show satisfactory agreement among themselves and with those obtained by the original method. P. G. H.

1019. Importance of Distillation Tests in Classifying Oils. W. L. Nelson. *Oil Gas J.*, 16.6.38, **37** (5), 62.—In spite of its imperfections, the A.S.T.M. distillation curve is of great value in classifying or comparing light oils, owing to the data available for purposes of comparison. In the examination of kerosine or gas-oil the A.S.T.M. curve has little significance, but it can be of service in a refinery because for a given crude the curve is related to other more significant properties. In the case of gasolines the A.S.T.M. curve has assumed great importance because it has been correlated against road performance. Ease of starting, warming-up characteristics, acceleration and power, and crankcase dilution and their relation to the 10%, 35%, 60–65% and 90% A.S.T.M. distillation temperatures are discussed and maximum ranges for summer and winter usage suggested. Curves show limits between which gasolines for regular service vary, the minimum volatility range for satisfactory use during the warmest part of the summer and a suitable range for operation at temperatures 10° or more below zero.

For engineering and designing purposes undue significance must not be attached to the A.S.T.M. curve. True-boiling distillations, such as those determined on the equipment developed by Peters and Baker, are the nearest measure readily available for ascertaining the actual distribution of hydrocarbons. In general, the true-boiling point analysis shows much more low-boiling material than is indicated by the A.S.T.M. distillation, and also shows the presence of high-boiling material not evident in the A.S.T.M. distillation.

Not a great number of true-boiling-point distillations have been made, but with the data available, curves which enable construction of a true-boiling-point curve from the A.S.T.M. curve of products with 50% boiling-point temperatures of about 200–600° F. are presented. From the data available to the author the difference in temperature between the two curves at the 99% point is never more than 25° F., and sometimes as little as 7° F., indicating that A.S.T.M. end-point is a fair indication of the high-boiling material in the sample.

The relation between A.S.T.M. end-point of a fraction and the true boiling point cut point of the fraction is sensitive to the equipment used for determining true boiling point and the method of operation employed. R. A. E.

1020. Technic of Anti-Freeze Testing. H. Hoover and F. E. Dolian. *Industr. Engng Chem. Anal.*, 1938, **10** (6), 293–297.—Since, in the cooling system of an automobile engine, there are several different metals and alloys in contact with one another and the cooling medium, the conditions are very favourable to electrochemical corrosion; this is further enhanced by the fact that, owing to leakage, the cooling medium is also subject to aeration. In addition, as an inhibitor for one metal may catalyze the corrosion of another, the problem of finding a group of inhibitors that will protect the whole system is complex.

To save time in preliminary investigation, the authors develop a technique whereby a large number of tests may be carried out simultaneously and the most satisfactory systems chosen for larger-scale examination. This consists in blowing air at a specified

rate through the anti-freeze solution contained in specified test-tubes in the presence of standard-sized pieces of soft steel, brass and solder, and 1 gm. of steel wool. The test is stopped and the test-pieces are weighed at the first sign of rust. If no rusting occurs in 6 weeks, the tests are stopped, as if there is no serious attack on steel, brass or solder in this time, further investigation is worth while.

In the final tests a procedure as close as possible to that existing in practice is used. The solution is circulated continuously through a closed system in which it comes into contact with the same materials as in a cooling system, and heat interchanges take place in similar conditions. Throughout a test temperatures and the rates of pumping are kept constant, and the solution is aerated at a constant rate. Before the test proper the system is filled with water, which is circulated at the working temperature for 24 hours; this "pre-rust" period serves to form a coating of rust over all the iron surfaces. Two sets of test-pieces (soft steel, copper, brass, aluminium and solder) are placed in the test-chamber during the pre-rust period, one of which is removed at the end of this period, whilst the other remains in the system with seven additional sets added when the test proper starts.

During the test the p_H of the solution is checked, and a set of test-pieces removed and weighed, once a week. As soon as rusting is apparent, a set is withdrawn, and any others remaining at 1–2 day intervals. The progress of corrosion is followed by the loss in weight of the test-pieces. By comparing the losses in weight of the last of these sets with that of the two pre-rust sets, it can be determined whether the anti-freeze solution attacks clean surfaces more than previously corroded ones.

Attack on rubber is determined by immersion of a section of radiator hose in the solution at the operating temperature for 6 weeks, and noting its appearance, or, preferably, by examining the section of hose used in the metal-corrosion-test system. If it survives without undue swelling or loss in strength, the anti-freeze is considered satisfactory. Similarly, any tendency to foaming would show up in the circulating system used for the corrosion tests.

The authors point out that, as the cooling systems of no two makes of automobile are identical, the final tests of a new anti-freeze must be made by road tests in a wide variety of cars. T. T. D.

1021. Fuel System Characteristics. Results of Pawhuska Road Tests as Viewed by Automotive Engineers. W. G. Lovell, J. M. Campbell and M. J. Mulligan. *Oil Gas J.*, 19.5.38, **37** (1), 82.—An apparatus used for measuring the volume of vapour given off by various gasolines at atmospheric pressure under equilibrium conditions consists essentially of a 100-ml. glass burette calibrated to 0·2 ml., filled with dry mercury and connected to a levelling bulb. The burette is provided with a three-way stop-cock, so that liquid samples can be metered into it from a 5-ml. burette immersed in an ice-bath. The gasoline samples are introduced as received, and, to ensure equilibrium conditions, the apparatus is provided with a motor-driven stirring mechanism for agitating both liquid and gas contained in the measuring burette. The pressure of vapour in the burette is brought to atmospheric by means of the levelling bulb at each temperature at which measurements are made. Curves of the volume of gas evolved per unit volume of gasoline, or the vapour to liquid ratio, against temperature can be readily made from the measurements. Curves of four gasolines having Reid vapour pressures of 8–14 lb. Reid at 100° F. are illustrated. There is reason to believe that car conditions are not too far from equilibrium, so that by comparing the experimental data with carburettor fuel temperature at the time of vapour lock in a car, the vapour tolerance of the fuel system can be estimated and vapour-locking tendencies of gasolines of known characteristics predicted with a fair degree of accuracy. The curves for the four gasolines previously mentioned show that there is not necessarily a very exact correlation between vapour pressure and vapour evolved. In fact, a gasoline of lower vapour pressure may evolve more vapour at certain temperatures than one of higher vapour pressure. Such a gasoline might be expected to have more tendency to vapour lock than the other, and this has been demonstrated experimentally in cars.

From the curves the amount of fuel evaporated can be computed from the volume of gas evolved, assuming the vapour evolved to be butane. A vapour volume of 5 corresponds to 1·8% by vol. of the liquid evaporated. With most cars high fuel loss and vapour lock go together, and car tests show that observed losses from the carburettor seem to agree with those estimated from the curves and observed tempera-

tures. Losses, therefore, cannot be very high, or the car will not run. Vapour losses from the rear tank, which, according to the Pawhuska tests, are quite large and about half of the total losses, represent a condition which the authors cannot explain. Experiments carried out by connecting a condenser cooled in solid CO_2 to the vent of the tank showed only insignificant losses when there was no vapour lock. This seems reasonable, since Pawhuska tests show that tank temperatures average only 5° F. above atmospheric, so that losses of the order of 0·5% might be expected, and this has been confirmed by other tests. Suggestions for final presentation of the road-test data are given in order that an attempt may be made to ascertain the causes of the apparent discrepancies mentioned. R. A. E.

1022. Inflammability of Oil Films on the Surface of Water. W. L. Nelson. *Oil Gas J.*, 12.5.38, **36** (52), 148.—Results of tests conducted at 75° F. in a room free from air movement are given. Samples used included gasolines, kerosine, lubricating oil, asphalt and crude oil, and an open flame was used for ignition. In some of the tests oils were spread over the entire surface of the water by means of a stirring-rod. This probably produced a slightly thicker film at the edges, due to creeping up the walls of the container, and may account for the greater inflammability observed in this series. In all other tests oil was permitted to spread to its own natural thickness without touching a confining wall. When oil is dropped on water it tends to spread rapidly and then maintain a nearly constant area in the absence of currents and waves. Gasoline films assume a nearly constant thickness in a few seconds, but viscous oils spread very slowly. The thickness of oil films without confining walls ranges from 0·07 to 0·006 in. To cover 0·01 sq. mile of surface requires 12,180 gals. for 0·07 in. thickness. The minimum thickness of gasoline film that can be ignited without fail is about 0·0035 in. The time that elapses before application of the flame is important, since the thickest gasoline film (0·015 in.) would not ignite after an exposure of 25 min., whereas it would burn for several seconds if ignited just prior to this period. In thinner films (0·0037 in.) ignition is not possible after about 5 min. exposure. Gasoline does not assist heavier oils to burn, and in fact usually does not burn so well in admixture as alone. This is probably due to decreased vaporization owing to dilution, and to the fact that the heavier material is not heated to a temperature sufficiently high for combustion, owing to the efficiency of the large body of water in conducting heat away from the oil film. The main conclusions are that for oil free to spread over the surface of water at prevailing atmospheric conditions, (1) only gasoline and some light naphthas will ignite or burn, (2) large quantities of gasoline are necessary to cover even a few acres of water, (3) the gasoline weathers rapidly and will not ignite after short exposure, (4) gasoline will not ignite other heavier oils either when mixed or lying adjacent to them on the surface of the water. It appears that, due to conduction of heat from the film by a large volume of water, no oil can burn unless its fire point is lower than the water temperature. Experimental results are tabulated. R. A. E.

Motor Fuels.

1023. Fischer–Tropsch Process for the Synthesis of Gasoline. M. Naphtali. *Refiner*, Feb. 1938, **17** (2), 47.—The production of gasoline, diesel oil, lubricants, paraffin wax, ceresin, alcohols, etc., from coal is possible by the application of the low-pressure Fischer–Tropsch process. Some 500,000 tons of gasoline were so produced in 1937. A 1–2 mixture of CO and H_2 is produced from pit coal and/or lignite and conducted over special catalysts. The choice of the catalyst influences, in some degree, the resultant product. In general three classes of material are produced: synthol, a mixture of alcohol, aldehydes and hydrocarbons; Kogasin I, a gasoline; and Kogasin II, a diesel oil. The effect of working conditions on the reaction and the products has been explained as follows: (1) rising pressure favours the production of synthol; (2) rising H_2 content increases the degree of saturation of the products; (3) increase of temperature tends to increase the yield of methane and, in the extreme, of C; (4) catalysts such as Fe, Co, Ni, increase the degree of saturation; (5) increasing age of the catalyst gives a relatively greater yield of gasoline. The reaction is exothermic and the theoretical yield is 210 gm. per m.^{3} of pure gas. Under optimum practical conditions the yield

is 140 gm. per m.^{3}, but higher yields have been obtained under laboratory and experimental plant conditions. H. G.

1024. German Synthetic Petrol. Anon. *Chem. Trade J.*, 8.7.38, **103**, 24.—At a recent Bayreuth meeting Dr. Pier stated that between 800,000 and 900,000 tons of gasoline—approximately 90% of the total German output—was produced in 1937 in Germany from domestic raw materials by the catalytic pressure-hydrogenation process. Most of the output consists of Leunabenzin prepared by direct hydrogenation of lignite tar. A series of additional plants for hydrogenation of lignite, bituminous coal and mineral oil residues is being erected in Germany. According to Dr. Pier, the fundamental discovery which enabled the development of this hydrogenation process was that of a sulphur-resisting catalyst capable of functioning under a variety of different conditions. Products manufactured from high-molecular, asphaltic and ash-containing raw materials which are processed in the vapour phase, show properties which are closely determined by those of their raw materials. The character of raw materials hydrogenated in the liquid phase, such as middle oils, brown coal-tar, etc., has less influence on that of the finished product than in the case of vapour phase hydrogenation, and the final properties of products can be modified to a much further extent by the use of different catalysts. From the hydrogen-rich mineral oils the highest yield of gasoline with good anti-knock value can be obtained. From hydrogen-poor raw materials motor gasolines with octane ratings of over 75 can be produced. Hydrogenated petrols have a marked sensitivity to addition of T.E.L.—*e.g.*, gasoline from asphaltic middle petroleum had an octane number of 77, which was increased to 91·5 and 100 by addition of 0·09% and 0·20% T.E.L., respectively. R. A. E.

1025. Conversion of Vegetable Oils to Motor Spirits. V. Th. Cerchez. *Monit. Petr. roum.*, 1938, **39**, 699–702.—Although Roumania has its natural petroleum resources, it is considered that attention should be paid to the production of alternative fuels. A general survey is made of the manner in which England, Germany and France are handling the problem of petroleum alternatives. Thus, while England and Germany utilize their rich coal deposits as the starting material for synthetic fuels, France utilizes her rich agricultural resources. Roumania might be advised to follow a procedure similar to that of France, and foster the use of ethyl alcohol and vegetable oils as fuels.

Hemp, flax, rape, poppy, sunflower, aniseed, castor, cotton and soya are all cultivated in Roumania, and tables illustrate the amount of each produced in 1935, and the corresponding potential oil yield. Thus 76,963 tonnes of sunflower oil, 19,185 of rape-seed oil, 6538 of hemp-seed oil, 4339 tonnes of linseed oil, and about 2000 tonnes of soya oil could have been produced. As it is, most of the seed was exported.

Data are given showing Roumania's own consumption of petroleum products in 1936, and attention is directed to the figure of 116,539 tonnes of spirit for which could be substituted synthetic products.

Maikle's work on the production of motor spirit from vegetable oil is outlined. Linseed, rape and arachis oils were subjected to catalytic reaction at about 600° C. with simultaneous dehydrogenation and dehydration, the products being water, acrolein, gas and a liquid of low boiling range. The catalyst was powdered electrolytic copper and magnesia with alumina or kaolin. A soda treatment removes acidic bodies, and the liquid is then hydrogenated in the presence of a nickel catalyst. The yield from such a process is 300–350 kgm. of spirit per tonne of oil. Later, using a zinc chloride catalyst at 350–400° C., he obtained good yields in one operation. The experiments of Morrell, Egloff and Faragher on palm oil are also reviewed. These workers, operating at 420° C. and 90 kgm., obtained yields of from 62–71% spirit, and from 9·5% to 11% diesel oil, according to the origin of the oil.

France has an experimental factory in the Sudan for the production of motor fuels from oil seeds, but so far this plant has not been very satisfactory, there being only 11% yields from the seeds utilized.

The author claims that it should be possible to produce 400 kgm. of spirit per tonne of suitable oil. A suitable seed should yield 40% oil, and therefore to replace the 150,000 tonnes of spirit that Roumania will be using in the near future it will be necessary to cultivate 1,500,000 hectares to produce the requisite 1,000,000 tonnes of

seed. A further saving of natural petroleum would be effected by blending alcohol with the synthetic spirit.

In conclusion, the direct use of vegetable oils in place of diesel oil is supported and discussed. It is acknowledged that the former oils have several important disadvantages, such as poor atomization, in the absence of preheating, and lower calorific value. T. C. G. T.

1026. Patents on Motor Spirit. Gewerkschaft Mathias Stinnes. E.P. 486,170, 31.5.38. Desulphurizing motor spirit—*e.g.*, cracked benzine by subjecting it to a preliminary or subsequent hot alkali treatment under pressure and the whole hydrocarbon fuel is washed with diluted H_2SO_4 and only low-boiling fractions with conc. H_2SO_4.

Universal Oil Products Co., E.P. 486,355, 2.6.38. Production of low-boiling paraffin hydrocarbons by alkylation of *iso*butane with ethylene, *iso*butylene or normal butylenes at $-50°$ to $+10°$ C. in the presence of a catalyst comprising boron fluoride, nickel, and hydrogen fluoride and/or water.

Standard Oil Development Co. E.P. 486,631, 8.6.38. Improved motor fuel consisting of gasoline blended with *iso*propyl ether to which 0·5% of methanol has been added as an anti-freeze liquid.

Standard Oil Development Co. E.P. 487,986, 29.6.38. Motor fuel consisting of constituents boiling between 100° and 400° F. to which is added tetramethyl lead, dimethyl diethyl lead and monomethyl triethyl lead.

L. U. Franklin. U.S.P. 2,121,167, 21.6.38. Refining gasoline with sulphuric acid.

F. E. Kimball. U.S.P. 2,121,169, 21.6.38. Treatment of hydrocarbon vapours with ammonium pentachlorodizincate, ammonium chloride and hydrogen chloride. W. S. E. C.

Gas, Diesel and Fuel Oil.

1027. Corrosion by Diesel Fuels. Th. Hammerich. *Oel u. Kohle*, 1938, **14**, 539.—Twenty diesel fuels of various origin (petroleum, brown-coal oil, coal-tar, synthetic oils) were tested with respect to corrosiveness toward Zn. The loss in weight of a strip of the metal was determined after immersion in the oil at 50° C., 75° C., and 100° C. for 24 hrs. Tests at room temperature gave some indication of corrosiveness in practice; weighings were made at intervals for 7–56 days.

The principal conclusions were :—

1. The Zn strip test is adequately reproducible, but is only suited to qualitative distinction of corrosive and non-corrosive fuels.
2. Most of the samples tested during this work were virtually non-corrosive. A Roumanian petroleum oil, however, and two brown-coal oils showed exceptional corrosiveness.
3. The loss in weight of the Zn strip after 24 hrs. at 100° C. was found to give the clearest indication of corrosiveness. P. G. H.

1028. Improvement of Diesel Fuels by Extraction with SO_2. E. Steffen and E. Saegebarth. *Refiner*, Jan. 1938, **17** (1), 12.—The problem of obnoxious exhausts from high-speed diesel engines may probably be completely overcome by the application of the Edeleanu process. The selective solvent action of SO_2 removes those bodies primarily responsible for the undesirable character of the exhaust gases and produces fuels with greatly enhanced ignition quality, as indicated by raised aniline points, greatly reduced S contents and C residues. Cracked gas oils are shown to be particularly amenable to this treatment. These produce, with moderate quantities of SO_2, fuels which, on specification tests, are superior to straight-run fuels of accepted high quality. The extracts appear to be good charging stocks for cracking units. H. G.

1029. Operation of Liquid Fuel Burners. P. Chambadel. *Chaleur et Industrie*, 1938, 19, 120–122.—A discussion on the phenomena met in the atomization and vaporization of liquid fuels and in obtaining mixtures of these fuels with air. T. C. G. T.

1030. The Theory of Fuel-Oil Burners. A. Delaby. *Chaleur et Industrie*, 1938, 19, 114–119.—Methods of fuel-oil burning are classified in two groups: (*a*) vaporization and (*b*) atomization.

The inherent disadvantages of vaporization methods such as the necessity for auxiliary heating arrangements and other cold starting difficulties, carbon formation in preheaters, unsteadiness of control, etc., are outlined. The disadvantages enumerated in the article of this type of burner illustrate clearly the reasons for the preference shown by industry for the atomizing type of burner.

The high, medium and low air and/or steam pressure, and the centrifugal methods of atomization and the advantages and disadvantages of each type are surveyed.

All types of burners referred to in the article are diagrammatically illustrated.

T. C. G. T.

Lubricants and Lubrication.

1031. Improvements in Lubricants Used in Diesel Engines. C. C. Moore, Jun., U. B. Bray, and D. R. Merrill. *Oil Gas J.*, 16.6.38, **37** (5), 47. By far the major portion of the phenomenal increase in diesel usage since 1935 is accounted for by the newer medium and high-speed-type engines developing less than 500 h.p., particularly those of less than 200 h.p. Some outstanding lubrication difficulties of such engines are ring-sticking, scratching or scuffing, excessive wear and bearing failures.

Opinion varies as to whether the source of cementitious material which gives rise to ring-sticking is the fuel or the lubricant. First symptoms are abnormal blow-by escaping from the breather, a smoky exhaust and a loss of power for a given fuel-rack setting. Deterioration is rapid once blow-by due to ring-sticking commences, and continued operation under such conditions is destructive to piston rings and liners. Scratching is likely to occur during early operation of a new or rebuilt engine during starting after standing idle, or during sudden loading after idling at slow speeds. It may or may not be preceded by ring-sticking, but invariably leads to completely stuck rings due to blow-by. The cause appears to be the tearing away of metal particles first from the rings, next from cylinder walls and finally from the piston skirt.

Normal wear may be considerably reduced by choice of correct lubricant. The immediate cause of bearing failure is excessively high temperature, whether it be babbitt lining or the newer alloy-type bearings, which may be subject to corrosion by acidic bodies in the lubricating oil.

As a result of both theory and practice, it is believed that a crankcase oil should have certain properties to alleviate the difficulties mentioned.

(1) Detergency—*i.e.*, the property which assists in removing or preventing the accumulation of "dirt" on the engine parts. The detergent agent aids in preventing ring-sticking by (*a*) coating the metal surfaces with an adsorbed layer which prevents adherence of soot, etc., and (*b*) coating each particle of soot or other oil-insoluble material with an adsorbed layer, preventing agglomeration and assisting (*a*). Compounds may be evaluated by ascertaining their efficiency in removing lampblack deposition on cloth in lubricating oil and Stoddard solvent solutions. Only those oils which contain soap-type addition agents show a high order of detergency by such methods of test and also a high standard of anti-ring-sticking properties. Soaps currently found in diesel oils include aluminium naphthenate and various calcium salts, especially dichlorostearate. Addition of such soaps may effect improvement in performance of oils of any type, but as a rule well-refined naphthenic oils are used as base stock, since without addition of soap they give minimum difficulty from ring-sticking and sludging. Photographs of pistons after tests show the superiority of the oils containing soap addition.

(2) The importance of high film strength as a measure of prevention against scratching or scuffing in diesel engines is stressed, and as a rough guide a minimum of 15 lb. loading on the Timken film-strength machine in combination with a soap-type additon agent appears desirable. The efficiency of calcium dichlorostearate in preventing scuffing is illustrated by photographs of ring surface structures after tests.

(3) " Oiliness," defined as " that property which results in a reduction in wear under normal operating conditions." The ideal " oiliness " agent is one which will protect against both abrasive and corrosive cylinder wall wear. High-mol.-wt. organic compounds of the oxygenated type appear to be effective as oiliness agents. Carefully controlled engine tests have shown that oil compounded with 1·33% calcium dichlorostearate reduces wear of cylinders and rings very appreciably when compared with high-grade mineral oil. The relationship between film strength and oiliness is discussed.

It will be seen that from the three aspects so far discussed calcium dichlorostearate provides a suitable addition agent which is soluble in mineral oil. In combination with a properly chosen naphthenic base oil, it has been found also to give a particularly soft type of carbon formation on the piston. To obtain maximum benefit from soap addition, the base oil should be thoroughly stable, and an oxidation stability of at least 15 hrs. for the 10 mgm. point in the Indiana oxidation test has been taken as a primary control. The stability of chlorinated soaps was found by experiment to be sufficient to insure freedom from deposition in the crankcase.

None of the soap-type addition agents used commercially at present is appreciably corrosive to babbitt under prevailing temperatures, but all are definitely corrosive to cadmium–silver, copper–lead, and other alloy type connecting-rods and main bearings. Consequently, the application of the doped oil has been restricted accordingly, and the search for a non-corrosive product is being continued. R. A. E.

1032. Behaviour of Lubricating Oils in a Diesel Engine. H. Kern. *Oel u. Kohle*, 1938, **14**, 389.—Thirteen oils, differing in origin and physical properties, were used in turn to lubricate a single-cylinder diesel engine operating under standard conditions (1550 r.p.m.; oil and cooling water temperature, 80° C.). 5 litres of oil were initially taken in each case, and each run was continued without replenishment until the oil had been reduced to 200 c.c. by use and by abstraction of samples (up to 160 hrs. maximum).

Samples were withdrawn every 10 hrs. and were tested for viscosity (50° C. and 100° C.), solid foreign material, ash, d_{20}, and asphalt. The results were plotted graphically against hours of use for each oil.

The chief results were as follows :—

1. Two commercial grades and one reclaimed oil (E_{50}, 9·2–9·75°) showed increases in viscosity and d_{20} which corresponded to increase in solid material (maximum attained was 6% ca.). Ash and asphalt did not exceed 0·15% and 0·5%, respectively, at end of tests. These were stated to be reasonable values. It is concluded that the reclaimed oil was as suitable as the new oils.

2. An unusually thin oil (E_{50}, 5·18°) showed no signs of excessive consumption, and none of its characteristics reached impracticable values at end of test. Two oils which failed the Daimler–Benz specification on account of high viscosity (E_{20}, 12° and 16°) were used up very rapidly, the tests ending after 62 and 80 hrs., respectively; high consumption was due to ring-sticking, which caused oil to accumulate in combustion space.

3. Since lubricating oils of different nature and initial asphalt content gave practically the same asphalt and solid material contents at end of tests, the nature of fuel was thought to play a large part in asphalt formation.

A poor fuel (cetene No. 35) was found to cause large increase in ash content and E_{50}. This was attributed to wear, which was caused in some way by the fuel.

4. Addition of fatty oils inhibited wear, but caused ring-sticking, which curtailed the tests. Compounds containing P, S, or Cl caused rapid increase in ash and viscosity owing to corrosive wear of cylinder. P. G. H.

1033. Composition of Lubricating Oil. F. L. Carnahan. *Oil Gas J.*, 30.6.38, **37** (7), 66.—Results of research carried out at the Pennsylvania State College are reported and discussed. Vacuum fractionation tests were carried out on a Pennsylvania oil of viscosity S.U. 325 secs. at 100° F. and viscosity index of 105, and on a commercial oil of viscosity S.U. 186·6 secs. at 100° F. and viscosity index 45. The fractions and bottoms were tested for viscosity A.P.I. grav., viscosity index and gravity index. The Pennsylvania oil fractions show little variation in viscosity or gravity indices,

indicating that each cut is of substantially the same molecular type. The commercial oil fractions vary in viscosity index from −19 to +48 and in gravity index from 15 to 37; the bottoms had a viscosity index of 89 and a gravity index of 80. These results show that this oil is not homogeneous in molecular type. Various oils were classified by determination of the percentage of carbon atoms in aromatic rings, *cyclo*paraffin rings and paraffinic side-chains, and the results tabulated together with the ratio of the percentage of carbon atoms in paraffinic side-chains to those in the *cyclo*paraffinic rings. Pennsylvania neutral oils and bright stocks are shown to be similar in distribution of carbon atoms and to have an average ratio of 5·5. Mid-Continent neutral and extra neutral oils and extracted Western neutral oils show ratios of 2·56, 3·32 and 2·22, respectively. A synthetic hydrocarbon showed 33% of carbon in aromatic rings and 67% in paraffinic side-chains. All these oils, except Pennsylvania bright stock, possessed viscosities S.U. at 100° F. of 171 to 207 secs., and, with the exception of the Mid-Continent neutral viscosity indices ranging from 97 to 101. This illustrates that widely different compositions may give nearly the same physical properties in several respects.

Reflux extraction tests have been carried out with the aid of acetone on Pennsylvania and Mid-Continent neutral oils. Results of tests on selected cuts showing yield of fraction, viscosity, viscosity index, A.P.I. grav. and distribution of carbon atoms are tabulated. The earlier cuts contain hydrocarbons with a high proportion of aromatic rings, whereas later fractions contain none. As separation proceeds, the proportion of carbon atoms in *cyclo*paraffinic rings decreases, but some must exist, or the product would naturally be wax. The early cuts possess low viscosity indices, whereas later cuts have viscosity indices as high as 120 or more. The results show that Pennsylvania 200 neutral has about four times as much material present of 120 or greater viscosity index as does a Mid-Continent neutral of about the same viscosity. Recently distillation and extraction procedures have been combined by subjecting a fraction with a limited range of mol. wt. to the solvent extraction process. The combination of the two methods gives a particularly intimate picture of oil constitution.

R. A. E.

1034. Studies in Lubrication: I. Theory of Thick Film Lubrication of a Complete Journal Bearing of Finite Length. M. Muskat and F. Morgan. *J. Appl. Physics*, 1938, **9**, 6, 393.—A theory is developed for journal bearings of finite length, which takes into account the lubricant source (assumed to be set 90° in advance of the maximum film thickness) and end leakage. It is shown that the bearing eccentricity and the friction are not uniquely determined by the Sommerfeld criterion, as is found for bearings of infinite length, but depends also on the pressure of the oil supply and on the leakage. For the position of the lubricant source given above increased pressure of lubricant supply results in increased friction coefficient and eccentricity. The theory also demonstrates that the load-carrying capacities of bearings of finite length are less than those assumed to be infinite, and decrease with increasing pressure of lubricant supply if the latter is placed in the low-pressure part of the film.

The calculations are made as a series of approximations, and it is shown that the third and higher may be neglected for eccentricities less than 0·4. P. D.

1035. Film Lubrication of Finite Curved Surfaces. S. M. Skinner. *J. Appl. Physics*, 1938, **9**, 6, 409.—The solution of the problem of the film lubrication of a plane surface of finite width was solved by Michel. Curved surfaces (journal bearings) of infinite width had previously been treated by Reynolds, Sommerfeld and others. In the present paper equations are derived applicable to finite rectangular bearings curved in both directions. An approximate solution is also obtained for the journal bearing of finite width. P. D.

1036. Patents on Lubricating Oil. Standard Oil Development Co. E.P. 486,902, 13.6.38. Production of voltolized oils by passing a silent electric discharge at pressures below 20 cm. Hg through a destructively hydrogenated lubricating oil having a viscosity of 10 secs. Saybolt at 210° F.—for a time sufficient to increase the viscosity between 2 and 15%.

N.V. de Bataafsche Petroleum Mij. E.P. 487,313, 17.6.38. Manufacture of E.P. lubricants in which humic acids or natural or synthetic products containing such acids are incorporated in mineral lubricating oils or greases.

Standard Oil Development Co. E.P. 488,026, 28.6.38. Voltolization of fish oils mixed with petroleum, mineral oils, or waxes or shale oil in an atmosphere of H_2, N_2, CO, CO_2, O_2 or air, and in the presence of S, Se, H_2S, P, a halogen, boron fluoride, or a ketone.

W. W. Triggs. E.P. 488,063, 30.6.38. Propane dewaxing of lubricating oils.

U. B. Bray. U.S.P. 2,119,733, 7.6.38, C. E. Adams and F. W. Scheineman. U.S.P. 2,122,019, 28.6.38. Propane dewaxing of hydrocarbon oils.

D. R. Merrill. U.S.P. 2,119,749, 7.6.38. Method of continuous filtration of wax in propane dewaxing.

K. L. Wallin. U.S.P. 2,119,759, 7.6.38. Method of separation of wax from wax-asphalt mixtures obtained from oils containing the same.

J. M. Whiteley. U.S.P. 2,119,871, 7.6.38. Solvent refining of asphalt-free oil using as solvent a mixture of propane and ethane.

C. D. Barnes and M. T. Flaxman. U.S.P. 2,119,938, 7.6.38. Propane-dewaxing of hydrocarbon oils using a separation acid consisting of oxidized wool-grease.

D. E. Carr and M. L. Wade. U.S.P. 2,119,940, 7.6.38. Production of oxidized wax from slack wax separated from S.A.E. 50 waxy lubricating oil distillate.

C. E. Lauer and L. V. Phillips. U.S.P. 2,120,135, 7.6.38. Treatment of residual paraffinic oils with acid for the manufacture of cylinder stocks.

U. B. Bray. U.S.P. 2,120,209, 7.6.38. Counter-current solvent extraction apparatus.

G. L. Parkhurst. U.S.P. 2,120,810, 14.6.38. Solvent extraction of hydrocarbon oil using phenol and liquid SO_2.

L. P. Evans. U.S.P. 2,121,318, 21.6.38. Box counterflow apparatus for solvent refining of hydrocarbon oils.

R. E. Manley, B. Y. McCarty and H. H. Gross. U.S.P. 2,121,323, 21.6.38. Solvent extraction of hydrocarbon oils using furfural.

D. R. Merrill. U.S.P. 2,121,325, 21.6.38. Solvent extraction of hydrocarbon oils using benzene and SO_2.

R. E. Burk and E. C. Hughes. U.S.P. 2,121,420, 21.6.38. Dewaxing apparatus.

F. W. Breth and A. Kinsel. U.S.P. 2,121,518, 21.6.38. Refining petrolatum by filtering it at 130–400° F. through activated bauxite under at least 30 lb./sq. in. pressure in excess of atmospheric.

D. K. Harger and H. I. Wolff. U.S.P. 2,122,059, 28.6.38. Refining of lubricating oil with acid and then adsorbent substances. W. S. E. C.

Asphalt and Bitumen.

1037. Bitumen Emulsions E. Vellinger (Paper read at the "Semaine de Perfectionnement," Ecole du Petrole, Strasbourg). *Rev. Pétrolif.*, 1.7.38, (792), 866.—The viscosity of bitumen emulsions is of great importance in the process of surface dressing. Stearine pitch has been added to increase too low viscosities, but such emulsions show a high degree of thixotropy, and their viscosity is extremely susceptible to temperature changes, falling, for example, to 1/5 for a temperature rise from 20 to 35° C. Better results are obtained by the admixture of sulphonic acids.

The Einstein formula is no use for explaining the viscosity phenomena of such emulsions, which the author suggests are the result of the frictional action of active molecules adsorbed to the interfaces within the emulsion. For example, the addition of a small quantity of heavy metallic salts increases the rate of break—a phenomenon connected with the interfacial tension—and this increase is accompanied by a fall in viscosity.

The property of adherence to gravel is explained by the existence of "adhesiphores" dissolved in the bitumen, as neither the asphalthenes nor the malthenes appear to possess any perceptible surface activity. When hot mixing 10 gm. bitumen with 50 c.c. gravel and immersing in distilled water, in the most unfavourable cases the gravel lays bare after one or two days, but in the presence of certain adhesiphores the coating remains for several hundred days.

The composition of the adhesiphores has not yet been discovered, but substances of similar action have been prepared by the chlorination of oleine in the presence of sulphur. Highly active compounds are also obtained by the condensation of oleine in the presence of aluminium chloride.

It is thus shown that, similar to other organic substances (caoutchouc, drying oil, resins, etc.), an activation is also possible with bitumen, although the improvement obtained so far is not yet satisfactory. L. R.

1038. Hardening of Asphalt with Relation to Development of Cracks in Asphalt Pavements. P. Hubbard and H. Gollomb. *Proc. Ass. Asph. Pav. Technol.*, 1937, **9**, 165–194.—The authors discuss the reasons for cracking in asphalt pavements, and point out that undue hardening of the asphalt has occurred in all cases examined by them, as shown by the low penetration. Previous experiments by the U.S. Bureau of Public Roads had shown that hardening was more rapid the thinner the film, the higher the temperature and the longer the period of contact with air. It has been shown by exposure to light, heat, air and moisture that moisture is a negligible factor in the hardening, whilst light has only a slight effect on the surface. Hardening is believed to be mainly due to oxidation, which may occur during hot mixing and on the road after several years. The data indicate that the following expectancy of cracking due to hardening of the asphalt cement in the pavement exists in temperature climates where freezing temperatures are common in the winter.

(*a*) asphalt less than 20 penetration—bad cracking.
(*b*) asphalt higher than 30 penetration—no cracking.
(*c*) asphalt higher than 20–30 penetration—uncertain.

The penetration of a 50-penetration asphalt may be reduced to 35 in hot mixing operations, and thus approach the limit at which the pavement might crack; the use of a higher penetration asphalt is therefore desirable. Investigation of the hardening of asphalt during plant operation and laying showed that, in general, hardening was much greater than could be caused by volatilization or distillation.

To obtain quickly some measure of resistance to hardening, an accelerated laboratory test involving exposure of the asphalt as it exists in a paving mixture to the action of heat and air was devised. Mixtures of various asphalts from the same and different crudes with limestone filler (12·1%) and sand (77·4%) were subjected to various temperature and time conditions in ¼–¾-in. layers. With Venezuelan crude it was found that no increased resistance to hardening occurred with partly oxidized or fluxed asphalts as compared with straight-reduced asphalt of 50 penetration. When compressed into briquettes, the samples were found to harden to a much smaller extent.

The authors have standardized the test to half hour at 325° F. with the mixture in a loose layer, and found that with nine asphalts of 50 penetration the recovered asphalt was 32–38 penetration.

It is concluded that in order to prevent or reduce cracking in pavements, it is advisable to use as soft an asphalt as possible, as high a percentage of asphalt as possible subject to displacement by traffic, to prepare mixtures at the lowest possible temperature, to compress all paving mixtures thoroughly so that they will be impermeable to air, and to seal coat mixtures which are still readily permeable. The authors consider that a definite need exists for the development of a reliable test of the tendency of bitumen to harden. A. O.

1039. Patents on Asphalt. V. L. Shipp and A. H. Boenau. U.S.P. 2,120,376, 14.6.38. Manufacture of asphalt by air-blowing blended mixtures of residues of paraffin-base crudes and solvent extracts of paraffin-base stocks together with solvent tars of asphaltic and mixed base residues.

V. L. Shipp, A. H. Boenau and J. W. Ramsay. U.S.P. 2,120,377, 14.6.38. Manufacture of asphalt by air-blowing solvent tar from petroleum residues to a penetration value of >30 at 77° F. and adding an oil of relatively high viscosity index.

E. B. McConnell. U.S.P. 2,121,437, 21.6.38. Manufacture of asphalt by heating petroleum residuum at oxidizing temperature exposed to O_3 until the material is partly converted into the desired specification, and then completing the treatment by further blowing with a gaseous medium providing O_3 and carrying a catalytic amount of seleno-sulphide.

D. G. Brandt. U.S.P. 2,121,517, 21.6.38. Apparatus for removing asphalt from asphaltic oils. W. S. E. C.

Special Products.

1040. Naphthenic Acids. E. Schmitz (Paper read at the "Semaine de Perfectionnement," June 13–20, 1938, Ecole du Petrole, Strasbourg). *Rev. Pétrolif.*, 24.6.38, (791), 834–835.—With different crudes, during distillation, the contents of naphthenic acids in the fractions increase, in general, progressively up to 250° C., and reach a maximum with the light-vacuum-distilled fractions. Further on acid contents fall continuously; sometimes, however, they rise again, eventually reaching—as, for example, in the case of four of the crudes tested—another even higher maximum for the last 10% distilled.

Tests on neutralization and saponification of crudes show that: (1) distillation with superheated steam even of a neutralized crude oil yields always acid distillates; (2) the crude naphthenic acids, in distillation, play a certain yet unknown rôle in the formation of chromophores having great influence on the coloration of distillates. Hence the conclusion is reached that the varying organic acidity of crudes should influence their method of treatment, especially with non-paraffinic crudes. In default of preliminary neutralization, distillates should be neutralized without regard as to whether they shall be subject to a final treatment.

Two hypotheses might explain the presence of acid compounds in the distillate of a neutralized crude: (1) new naphthenic acids and phenols are formed during distillation, or (2) extraction by caustic soda has not been complete and salts of naphthenic acids remained in the oil, and during distillation the respective acids are formed by hydrolysis.

Three different kinds of naphthenic acids were extracted from a Roumanian kerosine (Gura-Ocnitei) which had been subject to three different methods of treatment. One type of acid when dissolved in caustic soda gave a fine grenade coloration hitherto unknown with such compounds.

After discussing the structure of naphthenic acids—repeatedly referring to v. Braun—finally a list is given of the many uses of naphthenic acids and their derivatives.
L. R.

1041. Patents on Special Products. G. W. Johnson. E.P. 486,094, 30.5.38. Manufacture of butadiene by treating vinyl acetylene with solutions of compounds of divalent chromium, and if desired reducing the chromic compounds formed in the reaction mixture.

N.V. de Bataafsche Petroleum Mij. E.P. 486,161, 31.5.38. Manufacture of products of high mol. wt., soluble in mineral oils by condensing *iso*butene or *iso*pentene with olefinic hydrocarbons containing more than one double bond in which one or more hydrogen atoms have been replaced by a halogen—below 0° C. in the presence of boron trifluoride as catalyst.

I.G. Farbenindustrie A.G. E.P. 486,264, 1.6.38. Manufacture of butadiene from butylene glycol.

Distillers Co., H. M. Stanley, G. Minkoff, and J. E. Youell. E.P. 486,520, 30.5.38. Manufacture of aryl-substituted mono-olefines from benzene.

Distillers Co., H. M. Stanley, G. Minkoff, and J. E. Youell. E.P. 486,573, 30.5.38. Manufacture of aryl-substituted mono-olefins and derivatives—*e.g.*, styrene—by the pyrolysis of *iso*propylbenzene.

N.V. de Bataafsche Petroleum Mij. E.P. 486,707, 9.6.38. Insecticide consisting of copper salts of high-molecular sulphuric acid esters dispersed in water either alone or in the presence of other substances having an insecticidal or fungicidal effect and/or wetting agents.

E.I. Du Pont de Nemours & Co. E.P. 486,783, 9.6.38. Hydration of olefines to produce alcohols and ethers in the presence of boron fluoride or dihydroxyfluoboric acid.

W. W. Groves. E.P. 486,918, 7.6.38. Preparation of polymeric products from acetylene. W. S. E. C.

Detonation and Engines.

1042. Problem of Detonation. M. Serruys. *Aircr. Engng*, 1938, **10**, (111), 143.—An account is given of a series of experiments made on a variety of spark-ignition combustion chambers fitted to running engines. A study of the effects of detonation was made from pressure records obtained with the Farnboro' and Serruys optical indicators. Momentary high pressures were observed when detonation occurred, followed by a high-frequency oscillation of pressure. Temperature measurements showed that much more heat was liberated to certain parts of the combustion chamber under detonating conditions.

From his own work and that of other investigators, the author develops a theory to account for detonating combustion on the basis of nuclear ignition, without having recourse to any chemical hypothesis.

Data are given regarding the chemical conditions during the ignition of carburetted mixtures and regarding the influence of different characteristics of construction and running of engines on detonation. J. G. W.

1043. Measurement of Detonation. F. Postlethwaite. *Aircr. Engng*, 1938, **10** (113), 201.—The pressure effects due to detonation, as observed by means of cathode-ray engine indicators, are discussed, and it is shown that these take the form of a momentary rise in pressure, followed by a pressure wave of definite frequency. The detonation effects can be made more apparent by differentiation of the pressure diagram, but a still better method is to use a combination of electrical filter circuits to separate completely the detonation wave from the normal combustion pressure changes.

The author proceeds to describe the principles involved in the design of the R.A.E.–Mullard detonation meter. Piezo-electric crystals are used to obtain an electrical output proportional to the engine cylinder pressure, and, by means of additional compensating crystals, the effects of mechanical vibrations are eliminated. With the aid of an amplifier embodying band pass filters, the electrical effect corresponding to detonation is isolated. A gas discharge triode is used to measure the detonation output and is arranged to give a visual indication whenever the detonation exceeds a predetermined limit, the value of which can be read from a voltmeter.

Some notes are given on the use of the R.A.E.–Mullard detonation meter on full-scale engines operating under detonating conditions. J. G. W.

1044. Studying Engine Combustion by Physical Methods. L. Withrow and G. M. Rassweiler. *J. Appl. Physics*, 1938, **9**, 6, 362.—A great step forward has been made by fitting a glass observation window to the top of the cylinder. By this means it has been possible, using a high-speed cinematograph camera which is briefly described, to photograph the flame during a single cycle. Exposures of 1/6000 sec. are possible. A typical set of photographs is shown in which it is demonstrated that the flame

travels across the combustion space, a distance of 5 in. in 43° of crank angle, or 1/125 sec. It is found that as engine speed increases the rate of flame-propagation likewise increases.

By mounting a spectrograph above the window, emission spectra of various parts of the flame are obtained. The implications of the results obtained are discussed.

A further determination which may be made is that of the temperature, which is studied by the sodium line reversal method.

Comparison can be made between the high-speed photographs of non-knocking and knocking explosions, from which the occurrence of spontaneous combustion ahead of the normal flame-front and the more rapid flame travel in the latter can be seen. Pressure waves in the latter type of combustion can also be demonstrated by time-displacement photographs of the flames, and these can be correlated with the pressure as measured by pressure indicator. It is suggested that a pressure variation of 108 lb. per sq. in. occurs in these waves. The available information leads to the theory that the loss of power due to knock is due to the increased turbulence which results in a larger heat loss to the walls.

Absorption spectra of knocking and non-knocking combustion are compared, and the presence of formaldehyde in the former is demonstrated. P. D.

1045. Performance at High Altitudes of Injection Motors Having Compression Ignition. P. Clerget and R. Marchal. *Rev. Comb. Liq.*, April 1938, **16**, 133.—Experiments were carried out on a heavy oil motor fitted to an aeroplane. The motor which was fitted with a mechanical compressor giving an inlet pressure of 760 mm. mercury at 2700 m., had the following characteristics: compression ratio 14·5, nominal speed 1900 r.p.m. and a nominal output of 500 h.p. at 2700 m.

An ascent to 7650 m. was made without alteration of the engine controls. Graphs are given showing the conditions encountered during the ascent and the comparison with a gasoline motor of the same nominal characteristics. A study of the graphs shows the definite superiority of the injection motor with compression ignition. These results are explained by a consideration of the air/fuel weight ratio used during the tests. These ratios are stated to be about 31 on the ground, 25 at 2400 m., 21 at 4000 m., falling to about 14 at an altitude of 6000 m., when the saturation point is reached.

As long as the quantity of air admitted is sufficient for the complete combustion of the fuel, the calories produced are practically independent of the inlet pressure.

In conclusion, it is stated that neither low temperatures nor low pressures present any obstacle to the use of motors with compression ignition, and it is therefore suggested that the use of a turbo-compressor for this type of motor would be of great advantage. M. M. L.

1046. Internal-Combustion Engine. H. R. Ricardo. *Engineer*, 24.6.38, **165**, 702.—This brief review of the progress made in the design and operation of the internal-combustion engine during the last twenty years includes a novel presentation of the combustion process in both petrol and diesel engines; theories in regard to certain chemical and physical phenomena are illustrated by simple and well-chosen similes.

Following a discussion of some of the factors which enter into the development phase of the light high-speed diesel engine, the author quotes as an example of the progress made in the field for the smaller classes of commercial vehicle, a mass-produced engine turned out for taxi-cabs and light delivery vans. This engine, which incidentally is of Continental manufacture, is of only 1·7 litres capacity, yet develops 46 h.p. at a speed of 4000 r.p.m.

Turning now to the aero-engine, the author briefly outlines outstanding features of its present-day design. It is pointed out that, during the last twenty years, specific power output has been more than doubled, whilst the specific fuel consumption has been reduced to only about 60%, due mainly to improvements in the fuel. Examples of the power output gain which may be achieved by the utilization of fuels of different octane numbers are given, and reference is made to the possibilities of the single-sleeve valve in securing further improvements in aero-engine performance. In conclusion the economic possibilities of the two-stroke and four-stroke diesel engine for aircraft duty are discussed in comparison with the high standard of performance set by the modern 100-octane petrol engine. E. F. C.

1047. Precombustion Ignition Coal-Oil Engine. J. R. Kingston and W. R. Powell. *Engineer*, 10.6.38, **165**, 641.—An engine of this design is suggested as a possible solution to the problem of utilizing with equal efficiency attained by the more normal oil engine, the high spontaneous-ignition-temperature oils produced by the low-temperature carbonization process of coal.

Following a brief outline of numerous attempts which have been made to overcome combustion difficulties, the authors describe their earlier experiences with a four-cylinder engine having two power and two air-charging cylinders and embodying a separate combustion chamber lined with a special siliceous fire-clay sleeve; this chamber being connected to the working cylinders through admission ports controlled by special spring-loaded thimble-type valves. Fuel is injected into the combustion chamber through a single-hole open-type nozzle supplied by a simple fuel pump having a delivery pressure of only a few pounds per square inch above that attained in the combustion chamber. It was found that although the combustion cycle used satisfactorily solves the difficulty of no load and light load working with a high-speed engine using coal oils, owing to the fact that the maximum temperature permissible is limited to about 2000° F. to preserve the refractory lining in the combustion chamber, the mean effective pressure is somewhat too low for road-transport purposes. The introduction of an auxiliary injector which comes into operation only at full load to spray oil fuel into the excess air contained in the combustion products passing from the external combustion chamber, is proposed by the authors, together with additional improvements. The scheme, which has been tried with success in Germany, enables mean effective pressures up to about seven atmospheres accompanied with smooth running and relatively low maximum pressures to be readily attained for full-power working, under which condition the engine operates on a dual cycle—*i.e.*, partly continuous and partly internal combustion.

The authors conclude with a consideration of the thermal efficiencies that are possible with a cycle having isothermal compression and exhaust-heat recuperator, comparisons being drawn between the efficiencies of other thermodynamic cycles.

E. F. C.

1048. Whirl of Diesel Engine Crankshafts. G. J. Lugt and N. J. Visser. *Engineering*, 1.7.38, **146**, 21.—A mechanical method of measuring the movements of crankshaft journals in their bearings is described, and mention is made of an improved recorder embodying a cathode ray oscillograph.

It is stated that the position of the bearings does not fix the position of the nodes when the shaft is "whirling" at a critical speed, and that the shaft may be considered as "floating." This is partly due to clearance in the bearings and partly due to lack of rigidity in the framework.

Distortions observed in the whirl diagrams can be attributed to several causes, chief of which is the combustion force. This latter effect may lead to a "whipping" vibration of higher frequency than the primary "whirling" vibration.

The calculation of whirling speeds is discussed and some difficulties are mentioned. The method of using model shafts for obtaining the approximate position of the nodes is given.

The effect of whirl and whip on bearings and their lubrication is considered, and it is shown that such conditions are likely to lead to rupture of the oil film and fatiguing of the surface metal of the shaft in the region that is in contact with the bearing.

J. G. W.

ERRATUM.

Journal No. 178, August 1938. Page 325 A, Abstract No. 918. *For* "tetrahydroquinone" *read in each case* "tetrahydroxyquinone."

BOOK REVIEWS.

Bitumen and Petroleum in Antiquity. By R. J. Forbes, M.N.R.I.E. Pp. 112. 8vo. With 6 tables, 2 maps and 54 illustrations. 1936. E. J. Brill, Leiden. 2 guilders.

While the origin of petroleum is still a controversial subject, there can be little doubt that in one form or another it was known to the human race at an early stage in the world's history.

The evidence of this, and also of the fact that the knowledge was accompanied by the practical application of the material to the primitive arts and industries of ancient civilizations, is the subject-matter of the interesting and valuable contribution to the literature of petroleum made by Mr. Forbes.

It is not unusual for modern writers on petroleum subjects to refer to the eleventh chapter of Genesis, wherein appears the earliest Biblical reference to "slime" or bitumen, but few perhaps have noted the significance of the opening verse of that chapter, which states that "the whole earth was of one language and of one speech."

The task of Mr. Forbes would have been greatly simplified if this ideal state of affairs had persisted until the present time, for, as he points out in one of his early chapters, "one of the fundamental difficulties is the nomenclature of these bituminous materials."

But he has tackled the difficulty with characteristic thoroughness by utilizing a modern system of nomenclature and classification, that of Abraham, and tabulating in parallel columns the corresponding terms in Latin, Greek, Sumerian, Akkadian, Assyrian, Hebrew, Egyptian, Arabic, Turkish and Sanskrit.

This table and the accompanying notes which complete the first chapter of the book constitute a valuable feature which should be of great assistance to those who are interested in the derivation and meaning of the technical terms.

The second chapter, which is a long one of 20 pages, bears the heading "Where Bitumens were Found," and this title appears to be to some extent misleading, for while dealing very adequately with ancient and modern references in the literature to the existence of bituminous or similar deposits in various parts of the earth, there is included in this chapter a wealth of information relative to the analysis of ancient bituminous mastics, and of other bitumens from surface deposits and crude oils. In the opinion of the reviewer there is enough material relative to the composition and properties of these ancient bitumens to merit independent treatment, and the more so because a number of the samples referred to have been examined by the author himself by modern methods.

Although little is actually known about the methods employed for collecting and refining bitumen in ancient times, there is an excellent summary of the available references in the literature in Chapter III, and Mr. Forbes presents some interesting inferences and observations of his own relative to this part of his subject.

The last four chapters constitute more than half the total contents of the volume, and deal with the known or supposed applications of bitumens in ancient times.

Here the author devotes eleven pages to a carefully reasoned consideration of the probable form in which bitumen was applied. He points out that the majority of the uses required a product which, while plastic, should not flow in the heat of the sun, and he attempts to ascertain the probable nature of the mineral matter or filler with which the bitumen was incorporated.

It is interesting to observe the remarkable similarity between the ancient mastics and the bituminous compositions which have been evolved for specific purposes as a result of modern research. Mr. Forbes summarizes this section with the opinion that the standard mastic was one which contained about 25% of bitumen and a small percentage of fibrous material, together with mineral aggregate having about equal proportions of a sand and a filler. He states further that this composition has varied only very slightly during the whole period of Mesopotamian history, as far as may be concluded from the samples which have been analysed. He has pointed out,

however, that nothing is known about the composition of bituminous mixes used outside Mesopotamia in ancient times.

Dealing more specifically with the applications of bitumen, Mr. Forbes states that its most important use was as a building material, and he devotes considerable space, illustrated with many admirable photographs and drawings, to the discussion of the technique of brick manufacture, and the manner of applying the bituminous mastic in various examples of ancient buildings.

It would be outside the scope of this review to attempt a detailed survey of all the interesting facts which Mr. Forbes has collected into the small space represented by this slim volume; suffice it to say that the highway engineer, the modern architect and sanitary engineer, the compounder of paints, emulsions and cements, the cattle and chicken farmer, the horticulturist, the decorative artist and even the hairdresser and the maker of sealing-wax, together with many other modern exponents of the arts, crafts and sciences, will find something to interest them in this fascinating work.

The book is printed on good paper in a type which is somewhat strange to the average English reader. Moreover the width of the printed line, a full five inches, makes its perusal somewhat tiring to an eye accustomed to the customary four.

A few minor faults in the general make-up of the volume will doubtless be corrected in a later edition. For instance, Chapter I is wrongly headed Chapter II, and therefore does not correspond with the Contents. Again, the description of the samples mentioned in Table III has been wrongly included on page 10 at the end of Chapter I, although its proper place is obviously between pages 16 and 17, or, alternatively, at the end of Chapter II.

Only two misprints were discovered in a first reading, one in the description underneath the illustration on page 98, the other in the penultimate line on page 96 where a self-igniting mixture is referred to as being "hurdled" at the enemy!

The book concludes with a bibliography containing 160 references, and a small but adequate index.

J. McConnell Sanders.

Catalytic Processes in Applied Chemistry. By T. P. Hilditch and C. C. Hall. Pp. xxii + 478. Second Edition. Chapman & Hall, Ltd., Henrietta Street, W.C.2. 25*s*.

This valuable monograph first appeared in 1929, and it is not surprising that a second edition has been called for, having regard to the rapid development of catalysis in industry. Among the additional subjects discussed in the present volume appear the group of processes concerned with the production of liquid fuels from coal, tar, petroleum and water-gas. Further and strikingly important are the recent developments in the catalytic formation of "polymer" gasoline, of lubricating oils and other hydrocarbon material. The book begins with an account of the development and general theoretical aspects of catalysis at solid surfaces, in homogeneous systems and in the presence of enzymes.

Detailed sections follow on surface catalysis, and prominence is given to the production of hydrogen; the water-gas reactions; hydrogenation-cracking of tars, coal and oil; the synthesis of ammonia, nitric acid and sulphuric acid, and the hardening of fats (work in which field has been for so long associated with the name of Hilditch). Fermentation processes are fully considered, and the book ends with a discussion on homogeneous catalysis in liquid systems, including a useful chapter on the catalytic polymerization of organic compounds, rubber, polymer resins and polymer products of petroleum hydrocarbons.

It will be seen that the volume gives an admirable review of industrial catalysis. It is excellently documented, and will be found indispensable to the works chemist and his research colleagues.

A. E. Dunstan.

BOOKS AND PUBLICATIONS RECEIVED.

Geology of Grant and La Salle Parishes. By H. N. Fisk. Department of Conservation, Louisiana Geological Survey, Geological Bulletin No. 10. Pp. 246; 3 folding maps.

Grant and La Salle Parishes are in Central Louisiana between the flood-plains of the Red and Mississippi Rivers. The Urania oil-field is located in the N.W. of La Salle Parish. The discovery well was completed in 1925. The development of the Urania field in La Salle Parish was the chief cause of increased production for Louisiana in 1926, in which year the production was 4,050,000 brls. Since then production has shown a fairly slow but steady downward trend. The physiography and stratigraphy of the area are described.

The three folding maps are of Grant and La Salle Parishes, respectively, and a Structure Map of the Urania Oil-field.

Geology and Fuel Resources of the Southern Part of the Oklahoma Coal-Field. Part 3. The Quinton–Scipio District, Pittsburg, Haskell, and Latimer Counties. By C. H. Dane, H. E. Rothrock, and James Steele Williams. Pp. 253. U.S. Geological Survey Bulletin 874c. Superintendent of Documents, Washington, D.C. 65 cents.

The Quinton–Scipio district includes about 450 sq. m., mostly in Pittsburg County, but partly in Haskell and Latimer Counties, Oklahoma. Nearly 200 wells have been drilled in the district in the search for oil and gas, and gas has been produced from fields on the Kinta anticline since 1915. Coal has been mined intermittently in the district since 1902.

Structure and Gas Possibilities of the Oriskany Sandstone in Steuben, Yates, and Parts of the Adjacent Counties, New York. W. H. Bradley and J. F. Pepper. Pp. 68 + Map. U.S. Geological Survey Bulletin 899a. Superintendent of Documents, Washington, D.C. 35 cents.

The area covered by this report is in South-Western New York, and includes about 3000 sq. m. in Steuben and Yates counties and parts of the six adjacent counties. Domes likely to serve as traps for natural gas are concentrated in the north-eastern and south-western parts. Accumulation of natural gas in commercial quantities are likely to be found in domes at the Oriskany horizon formed either by the local north-eastward plunge of an anticlinal axis or by faults that cut across the axis.

Spirit Levelling in Vermont 1896–1935. J. L. Staack. Pp. 155. U.S. Geological Survey Bulletin 888. Superintendent of Documents, Washington, D.C. 20 cents.

This bulletin contains the results of all spirit-levelling in Vermont done by the Geological Survey, including those previously published.

The Freeman Assay for Coal and Carbonaceous Materials. Report by the Director of the Fuel Research Station on a Demonstration. 5 pp. H.M. Stationery Office. 3*d*. net.

The Report describes experiments carried out in a Freeman Assay apparatus in order to assess the correlation factor connecting the yield of tar from the Freeman Assay and that obtained from the Freeman Retort on which an official test was carried out in 1925.

Who Discovered the Trinidad Asphalt Lake? Percy E. Spielmann, Ph.D., B.Sc., F.I.C. Reprinted from *Science Progress*, No. 129, July 1938, pp. 52–62. (Presented by the Author.)

Dr. Spielmann has conducted an interesting piece of historical research into the oft-repeated statement that the asphalt lake of Trinidad was discovered by Sir Walter Ralegh in 1595, or alternatively that Ralegh had been anticipated by Columbus a century earlier in 1498. Neither of these voyagers, in the opinion of

the author, was acquainted with the asphalt lake near La Brea. Ralegh caulked his ships from the shore deposits of asphalt. His examination of the island was limited to a coastal survey. The earliest reference to the asphalt lake, in terms which have no ambiguity, is by de Levy writing in 1786. This was three years after the island was thrown open to development and trading by the Spanish Government. In 1797 a British squadron, with General Abercrombie and 4000 men, captured the island from the Spaniards. The earliest description of the asphalt lake published in England was that by Alexander Anderson (*Phil. Trans. Roy. Soc.*, 1789, **79** (Pt. 1) 65).

The only surprising point—upon which Dr. Spielmann comments—is that the island had been discovered for nearly 300 years before any description of the lake was published. The paper is accompanied by a bibliography of authorities consulted.

Study of a Solvent Analytical Separation of Waxes from Petroleum and its Lubricating Fractions. Joseph W. Horne and W. C. Hollinan. U.S. Bureau of Mines, Technical Paper 583. Pp. 16. 1 Folding Chart.

This report presents a basic method for the analytical separation of wax from oil, using selective solvents. It describes an apparatus and procedure which, it is claimed, may be adapted successfully to the analysis of almost all types of petroleum wax–oil mixtures, except heavy still bottoms and asphaltic products.

The method consists in dissolving a small, accurately weighed sample in a definite volume of acetone and methylene chloride solvent, chilling to an exact temperature, filtering, washing with a definite volume of chilled solvent and dissolving the wax through the filter. The wax is then freed of solvent and weighed.

Fractional separation of wax into cuts having distinctly different melting points was accomplished.

Institution of Mechanical Engineers, Proceedings, Vol. 138, 1938, January–April. Pp. xvi + 550. 12 plates. Published by the Institution, Storey's Gate, London, S.W. 1.

This volume contains ten papers read at various meetings of the Institution in January–April 1938, together with the Annual Report of the Council. The papers include "The Combustion Process in the Compression Ignition Engine," by J. W. Drinkwater and Prof. A. C. Egerton, presented at a meeting of the Internal-Combustion Engine Group of the Institution in Nottingham on April 4. The object of the researches described was to determine the extent of the chemical reactions of the fuel and air at various stages during the compression and expansion strokes.

Other papers include the Thomas Lowe Gray Lecture on "Recent Developments in Ship Propulsion," by Major P. L. Jones, and "Oil Engines for Tugs," by F. J. Mayer.

Imperial College of Science and Technology. Thirtieth Annual Report of the Governing Body for the year ending 31 July, 1937. H.M. Stationery Office. Pp. 136. 2*s.* net.

The Production of Active Carbon from Bituminous Coal. By J. G. King, D. MacDougall and H. Gilmour. Fuel Research Tech. Paper No. 47. Pp. vi + 55. H.M. Stationery Office. 1*s.* 3*d.*

An account is given of a new process for the production of activated coke by the carbonization of carefully selected coals of the hard durain type which do not intumesce on carbonization at 500° C. The process consists in carbonizing the graded coal at a temperature such that the coal is not heated above about 500° C. and treating the resulting coke with steam or steam and air in a continuous-vertical retort at about 950° C. During this process about 75 per cent. of the coke is gasified and a 25 per cent. yield of activated coke is obtained, which, by crushing and grading, can be made into graded active carbon.

Aeronautical Research Committee Report for the Year 1937. Pp. 42. H.M. Stationery Office, London. 2*s.*

Of particular interest are brief notes on work carried out during the year on the corrosion of radiator materials, fuel rating and lubrication. The report states that

the accepted method of rating fuels in terms of "octane number" is considered to be unsatisfactory where fuels of very high anti-knock value are concerned. Such fuels require a high compression ratio, with the result that the high explosive force of a non-detonating fuel may close the bouncing-pin gap in the C.F.R. engine and give a knock-meter deflection.

A large amount of experimental work has been done in connection with a possible revision of the existing Air Ministry Specification for Lubricating Oils, D.T.D. 109.

Code for Measuring, Sampling and Testing Natural Gasoline (Tentative) A.P.I. Code No. 50B. First Edition August, 1938. Pp. 18. Division of Production, American Petroleum Institute, Dallas, Texas. 35 cents.

Section I dealing with storage and measurement specifies the design, gauging and strapping of pressure and non-pressure tanks. Section II deals with the sampling of natural gasoline and other volatile petroleum products and specifies apparatus, sampling procedures and sequence of tests, whilst Section III gives an account of testing methods.

Studies Pertaining to the Catalytic Hydrogenation of Pyrolytic Tars. By H. M. Smith, H. T. Rall and P. Grandone. U.S. Bureau of Mines, Tech. Paper No. 587. Pp. 36. Superintendent of Documents, Washington, D.C. 10 cents.

This report presents experimental data on the hydrogenation of naphthalene in the presence of a number of different metallic catalysts. It is shown that hydrogenation to both the tetra- and deca-derivative in the gas phase is possible, the rate of the hydrogenation reaction depending on the concentration of the hydrogen, the temperature and the activity of the catalysts. The report includes an account of the hydrogenation using a nickel catalyst of naphthalene in the tar formed by cracking natural gas.

Porosity of the Sundance Sand in the Lance Creek Oil Field, Wyoming. By H. D. Nichols. U.S. Bureau of Mines, Report of Investigations 3410.

Results are given of 134 determinations and 11 estimates of the effective porosity of samples taken from 23 wells.

Natural Gasoline Plants in the United States, January 1, 1938. By G. R. Hopkins and E. M. Seeley. U.S. Bureau of Mines, Information Circular 7031.

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Geology.

1049. Search for New Oilfields. J. Roberts. *Petrol. Times*, 27.8.38, **40**, 269–271, 288.—The requisite conditions for the formation of an oilfield are briefly as follows: (1) A primary deposit which will yield oil on heating; (2) heat to be generated by crustal forces; (3) suitable conditions for the preservation of the condensed volatiles. The Los Angeles field is typical, for the oil-pools are parallel to the mountains and along the fault lines, whilst the heat was produced by the faulting and buckling. The distance of the "condenser" from the "generator" depends on the magnitude of the "retorting zone" and the intensity of the heat, but as a rule oilfields lie within 30–90 mls. from the axis of the generating zones.

Without exception the oilfields of the world are definitely associated with areas which have been subjected to great earth movements. Folding movements reduce the oil content of oil shales, and coalfields influenced by folding show the devolatilizing effect of the heat thus generated. In many cases the generator–condenser relationship indicates that the condenser (oilfield) will be beneath the sea. Adequate cover must be present to retain the oil in the condenser, and the parent substances must be present in the retorting zone. G. D. H.

1050. Activity in California. Anon. *Rev. Pétrolif.*, 29.7.38 (796), 968.—After a period of relative inactivity, prospecting has again come to the fore in California. The main work is being carried on in the San Joaquin and Los Angeles valleys. Four fields have been found in quite a small area in the San Joaquin valley. At Wasco the producing horizon is 13,000 ft. deep, and search is being carried down to 15,000 ft.

The beds are very jumbled in the Los Angeles valley, and it is necessary to search at depth for new fields. Lately two new deep oil horizons have been found in this valley. One lies east of Coalinga at a depth of 6849 ft., and on the Coalinga–Kettleman Hills anticline, 7 mls. from North Dome Kettleman Hills. This, a geophysical discovery, is to be called Guijarral Hills. The second is 1 ml. south of Torrance, at a depth of 5275 ft., and may be a new horizon or an extension to the Torrance field.

The conditions for geophysical work are very different from those of the Gulf Coast. Fifteen structures have been delineated seismically, and six out of the seven drilled have been productive. G. D. H.

1051. Oil Prospecting in Alaska. Anon. *Rev. Pétrolif.*, 2.9.38 (801), 1136.—In Alaska structures are known which are similar to those which are oil-bearing in California, and they are more extensive. The formations resemble those of Wyoming and Montana. Up to 1924 wells had only been drilled near seeps and to depths not exceeding 1000 m. A 5000-ft. well on Pearl Creek anticline (near Cold Bay) gave no signs of oil, but a deeper well being drilled on a 12-ml. anticline cutting Iniskin peninsula has shown some traces. It has traversed Jurassic beds. Another well is being drilled on the long, broad Bear Creek anticline in the Wide Bay area, 15 mls. from Pearl Creek. At Bear Creek there are seeps as at Iniskin. Concessions have been obtained in the Cordova–Katalla district about 75 mls. from the old Katalla field. G. D. H.

1052. Dramatic Change in Canada's Oil Position in 1937. J. L. Irwin. *Oil News*, 7.7.38, **44**, 7–8.—In June 1936 a well in S. Turner Valley came in at 850 brl. per day from the Madison lime, at a depth of 6828 ft. and 432 ft. in the limestone. It settled down to 550 brl. per day, but rose to its initial level on acidization. Oil was already known in that formation a few miles to the north. Other producers were brought in within a short time, giving a total potential of 26,803 brl. per day and an average of 766 brl. per well per day. Proration was introduced, and the outputs were successively reduced to 65%, 45% and 35%, and then raised to 42% on Jan. 15th, 1938. In April 1938 there were 45 producing wells. Further tests of potentials have been made.

At Taber oil is being obtained at 3000 ft. Wainwright, Ribstone and Red Coulee districts all have producing wells, and the extension of the Sweetgrass arch is being sought. New Valley north-east of Turner Valley seems to have good prospects.

G. D. H.

1053. Petroleum and Natural Gas in Alberta. Anon. *Oil News*, 11.8.38, **44**, 85–86.—In June 1936 Royalties No. 1 of Turner Valley came in at 6828 ft. in the Madison lime, giving much gas with a spray of oil amounting to 850 brl. per day.

Area No. 1, which was abandoned at 8988 ft., found shows of oil and gas, but not in commercial quantities. New Valley No. 1 gave a good show of oil in the Cardium series. In the Lundbreck area a well reached 4580 ft. without any substantial discovery of oil or gas. Several other tests are in progress.

During the year 1,483,258,000 cu. ft. of gas from Turner Valley were pumped into the field, the pressure on Nov. 31 being about 532 lb. per sq. in. G. D. H.

1054. Importance of Lispe Oil Discovery Proved. Anon. *Petrol. Times*, 27.8.38, **40**, 273.—The daily oil production at Bükkszék is 25 tonnes, and the Szentadorján–Lispe oil basin has become of considerable importance, for the fourth well has an output of 240–250 tonnes per day. This latter basin gives 300–320 tonnes of oil per day, which is about half of Hungary's domestic demand. The first well gave only gas. The fourth well revealed the oil horizon to be 6 m. thick, whereas the second and third found only 2 m. The field stretches from Nagykanisza to Nagyrécse and Galambok. More wells are to be drilled. G. D. H.

1055. Attock Oil's Production Prospects. Anon. *Petrol. Times*, 13.8.38, **40**, 219.—Production in the Khaur field began twenty years ago, and has been falling since 1929 when the daily average was 1200 brl., to 200 brl. per day last year. The Dhulian field has good prospects, for, although only a few wells have as yet been drilled, its production is already twice that of Khaur. The structure is about the same length as that of Khaur, but it is broader and flatter. G. D. H.

1056. Great Oil Region of the Caucasus and Near East; its Extensions and Subdivisions. J. Agababoff. *Rev. Pétrolif.*, 8.7.38 (793), 897–899.—In 1936 this region was estimated to have reserves of 4571 million tonnes—62% of the world's reserves.

The Caucasian and Near East region, with its extensions to the Red Sea and Arctic Ocean, consists of the following units :—

1. The primitive Russian platform running from the Arctic to the Great Caucasus possesses the Palæozoic fields of Ukhta, Krasnokamsk, Ishimbaevo, Samarskaya Luka, etc., which are in various states of development. In its Mesozoic and Tertiary cover are Emba, Dossor, etc.

2. The Tertiary chain of the Great Caucasus has peripheral fields on the Apsheron Peninsula, at Aliat, Grozny, Malgobek, Maikop, Taman, etc. East of the Caspian are the associated fields of Cheleken, Neftedag, etc., but in the same unit in Iran there are only the shallow wells of Mazandaran and the preparatory work in the Turkomenian steppes.

3. The Palæozoic Irano–Armenian chain unit is without any oil exploitation if Naphtalan on its border with the Great Caucasus unit is not attributed to it. There are seeps and favourable structures, but no serious work has yet been undertaken.

4. The Tauric and southern Iran Tertiary chains have the great fields of Haft

Kel, Masjid-i-Sulaiman, etc., in Iran, and Baba-Gurgur in Iraq on the southern margin.

5. The primitive Arabian platform possesses fields in Bahrein Island, Egypt, etc., deriving oil from Mesozoic and Tertiary beds.

The geosyncline between the two great platforms was divided by the Palæozoic movements which produced the Irano–Armenian chain. During the Tertiary movements the Great Caucasus arose in the northern geosyncline, and the southern Iran and Tauric chains in the southern geosyncline.

The stratigraphic as well as the structural distribution of the oil is of great interest, and characteristic stratigraphic columns showing the oil horizons are given for the Baku region, S. Iran, central Semnan Ghom, Iranian Azerbaidjan, Armenia, the primitive Russian platform and the primitive Arabian platform. G. D. H.

1057. Samara Loop. D. M. Preda. *Monit. Petr. roum.*, 1938, **39** (8), 599–601.—Between Stavropol and Syzran the Volga throws out a loop to the E. 60 km. in diameter. It encloses a boss of higher ground standing up above the great plain. Samara, now called Kuibyshev, is at the S.E. corner of this loop, and Syzran at the S.W. The plain here is a rich black-earth region, but is poorly cultivated under the unpopular Kolkhoz system.

Within the loop a chain of hills starts N.W. of Syzran and runs N.E. for 100 km., forming the northern edge of the loop. This is called the Jiguli range. It rises to 300 m. in some peaks. The rest of the loop slopes down to the S., but maintains a height of 20–40 m. above the Volga.

The Jiguli anticline begins in the W. with easy and symmetrical slopes, but from Syzran eastwards it shows an increasingly and more pronounced fault on the northern edge, amounting to 700 m. drop on the N. side, where it reaches the Volga. Longitudinal spurs from the main range give favourable sites for oil-formation.

Superficial signs of oil in this region have been long known, and as a result of recent drilling the first production was obtained in 1937. Many wells have been sunk at Syzran, and two oil-bearing horizons found, the upper one in the Middle Carboniferous, and the other in the Lower Carboniferous.

The upper level consists of two beds of sand, 4–5 m. thick, separated by a layer of shale. It gives 1–2 tonnes of oil per day of high sp. gr. and containing 1½–2% of sulphur.

The lower level is water-logged at the bottom, and only the upper layers are tapped. The latest well (No. 16) gave 130 tonnes per day at a pressure of 12 atmospheres. Density of the oil is 0·865; 7% distils below 100° C., 8% between 100 and 150° C. and a further 10% for each rise of 50° C. up to 300° C.

The author thinks the reserves are slight, but Russian experts are more optimistic, and drilling is going on at places E. of Syzran, and also S.W. The fault developed towards the eastern Jiguli seems to rule out that area. W. E. J. B.

1058. Carpathian Miocene and the Vienna Basin. D. Andrusov. *Petrol. Z.*, 1938, **34** (27), 1–9.—The structure of the Vienna Basin is considered in the light of the author's work in the central Carpathians. Considerable attention is paid to stratigraphy. This subject has developed without reference to the important variations in the Neogene of E. Europe, and consequently many of the views on the brackish water formations are obsolete. The present extent of the Miocene is governed mainly by the strong folding and faulting which took place in Miocene and Pliocene times. The effect of the faulting is more marked than that of the folding, which was at its maximum in the Burdigalian–Helvetian period. S. E. C.

Geophysics.

1059. German Geophysical Survey. O. Barsch. *II^me Congrès Mond. Pétrole*, **1** (Sect. 1), 1937, 23–26.—A properly planned geophysical survey is a necessary part of the means to be used for evaluating a country's mineral resources. Such work when left to private enterprise is unco-ordinated and its value lost by many of the details being inaccessible. A short description is given of the State Geophysical Survey in

Germany, and it includes the various methods in use, their application, and the organization of the survey. S. E. C.

1060. Report on the Geophysical Investigations Undertaken in Italy by the A.G.I.P. E. Soler. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 71–79.—The A.G.I.P. has made extensive use of geophysical methods, and especially of the gravimetric method, in the search for oil in Italy. The torsion balance has been used over 16,500 sq. km. in the Pô valley, and over 180 sq. km. in the Latin valley, and gravimetric observations have also been made. The existence of anticlines has been confirmed by drilling at Casalpusterlengo, S. Colombano, Fontevivo, Montepelato, Ferrara and Novi. The torsion balance work has been controlled by a number of pendulum observations.

The magnetic, electrical and seismic methods have also been used, and a description is given of a patented direct-current electrical method.

Tables are appended which show the regions studied, the areas, numbers of stations and the results. G. D. H.

1061. Developments in Exploration Geophysics since 1935. E. E. Rosaire. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 285–290.—The present outstanding characteristic of exploration geophysics in the U.S.A. is the wide application of the reflection seismograph to the sedimentary areas. The object of this activity has been the discovery of structural traps. So far drilling is the only practicable method of finding stratigraphic traps.

A development in seismic reflection methods is multiple recording, and a recent improvement on this is Rieber's method of "controlled directional sensibility." The main objection to the multiple-recording method is that the impulses are scrambled before being recorded; in Rieber's method they are recorded and then scrambled at will. Improvements in instruments include machine cranking, volume control and the elimination of oil for damping.

Amongst electrical methods the application of electrical transients to prospecting may be of great importance in locating faults. If so it will prove valuable in the Gulf Coast, where the best method so far of locating faults in the Tertiary is to drill holes and make electrical logs for correlation. S. E. C.

1062. Physicist and Tectonics. R. Maillet and R. P. Ceccatty. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 383–390.—The structures of the rocks as revealed by mapping must follow geological rules only, but when the mechanism and forces involved in the formation of these structures are considered, the realm of physics is entered, and the physicist is often perplexed by the geological hypotheses put forward. Direct measurement of the forces is not practicable, and experiments have therefore been made with models, using the principles of dynamic similarity. Such methods are valid only so long as the relationships regarding dimensions, time and the physical properties of the materials, as indicated by dimensional reasoning, are respected. On these grounds many experiments seem to be of questionable value.

From a consideration of various types of scale model experiment on this basis, it seems possible to assess the relative values of the different hypotheses regarding the nature of the forces involved, and the conclusion is reached that the sliding of sediments under the force of gravity alone, is much more important in "skin" tectonics than has been generally accepted. There seems to be no need to postulate lateral driving forces. G. D. H.

1063. Evolution of the Problems and Methods of Applied Geophysics. M. Schlumberger and R. Maillet. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 651–660.—Applied geophysics, largely a development of the last 20 years, depends on the specific physical properties of the rocks forming the earth's crust. The direct search for minerals by this means is of limited application, for a workable amount of mineral may not be large enough materially to affect the physical properties of the rock in bulk. The ores may not differ notably in physical properties from the surrounding rock, or may not be readily distinguishable from much less valuable minerals. The main development of geophysics depends on its application in an indirect manner—to reveal the

structural and lithological conditions of the crust which are likely to be associated with particular mineral deposits. Such methods can be used even when the physical parameters of the rocks have no specially distinctive values. Tectonical geophysics, which reveals the space relationships of a key horizon, is widely used in the search for oil. Stratigraphical problems cannot be solved by geophysics unaided.

Direct solutions of the problems of the three-dimensional distribution of rocks with certain physical characteristics are rarely possible with geophysics, and thus it is a question of seeking coincidences between observations and the pictures deduced by supposing certain distributions. In cases where such considerations do not lead to a unique solution, geological and drilling data are of further determinative value.

G. D. H.

1064. Thyssen Gravimeter and its Application in the Examination of the Saliferous Basin of Alsace. B. Favre. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 661–664.—The Thyssen gravimeter is convenient and quick in operation. In Alsace five or six points per day could be done, making two determinations at each station. The precision for an isolated observation is of the order of 1 milligal, and is as good as can be obtained in gravimetry. It was possible to trace the isogams without difficulty from milligal to milligal, and with sufficient accuracy for most geophysical work. The final deductions agreed well with those obtained from Eötvös torsion balance and resistivity surveys.

This apparatus seems a useful complement to the torsion balance, especially in reconnaissance. G. D. H.

1065. Astatized Pendulum as a Static Instrument for Gravity Measurements. G. Ising. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 665–670.—The theory of the astatized pendulum is outlined. The two principal practical difficulties involved in the use of this instrument are the effect of temperature variations on the value of the elasticity modulus and the sensibility of the pendulum to accidental tilting of its framework. The first is overcome by means of a double-walled casing containing ice, and the second by mounting the quartz pendulum in a heavy casing suspended in a suitable manner. The pendulum oscillates between two stops, and is never clamped, but no cases are recorded of its having been broken by external shock. The instrument may be automatically operated, or visual observations may be made. Field tests on the latest type have shown the mean error to be of the order of 0·5 milligal. S. E. C.

1066. Thyssen Gravimeter, 1935–1937. A. Schleusener. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 671–681.—The Thyssen gravimeter weighs only 15 kg., is easily transported, and requires no elaborate preparation for setting up. The temperature coefficient is very low, and special controls are therefore not needed. Daily variation is also low, and after being transported in one case for a distance of 550 km., the variation in reading at the control station was only 1·5 milligals. The mean error is of the order of 0·3 milligal. Measurements may be made in one of two ways. The instrument may be returned to the control point after each measurement, or successive measurements may be made at a number of stations before returning to the base. The second method is the more rapid, but the probability of errors is greater. Examples of actual surveys in Germany are given to illustrate the type of results obtained and show how they compare with torsion balance measurements. S. E. C.

1067. Problem of Determining the Overhang of Salt-Domes by Torsion Balance. R. Vajk. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 695–697.—For depths down to 500–1000 m. the density difference between salt and sediments is insignificant. At greater depths the difference is sufficient to cause an appreciable gravity anomaly, but mass must also be taken into account, and the mass of the overhanging salt is relatively small. Hence the determination of salt overhang by the torsion balance is impracticable. However, the contour of the salt below the overhang may be fairly accurately defined. If, therefore, a well located outside the calculated contour meets salt, it is probable that overhang is present. S. E. C.

1068. Magnetic and Gravimetric Measurements in E. England. J. H. Jones. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 699–705.—Magnetic and gravimetric surveys were made across Lincolnshire and Nottinghamshire. The instruments used in the traverse discussed were Watts vertical magnetometers and a small Süss torsion balance of the visual type. The relationship between the first derivatives of the magnetic potential and the second derivatives of the gravitational potential is demonstrated, and this relationship is then applied to the two-dimensional problem. The interpretation of both magnetic and gravitational anomalies was made by the polar-chart method. It was found that the sections obtained were very similar, and the conclusion is that the two anomalies have mainly the same structural origin. S. E. C.

1069. Magnetic Properties of Rocks Met in the Wells Drilled in the Search for Oil in Madagascar. A. Savornin. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 707–712.—The strong magnetic susceptibilities of the Permo-Triassic dykes of N. Madagascar show that in spite of the disturbances due to the cover of clayey-arenaceous rocks, the Schmidt magnetic balance can be expected to reveal the presence of such dykes even at depths of several tens of metres. On the other hand, it has not been found possible to use the magnetic properties of the sandstones and marls as a means of studying the gentle structures of this region. The ability of the Schmidt magnetic balance to locate these dykes quickly and cheaply makes it a useful aid in geological work.

The laboratory work shows that the Andrafiavelo wells have encountered a batholith, which could not have been foreseen, and that the stopping of drilling was entirely justified. G. D. H.

1070. Locating Pipe-Lines by Radio. C. M. Brecheisen. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 713–716.—Digging and prodding to find the exact position of a buried pipe-line are not necessary when the radio pipe-line detector is used. The radio transmitter is connected to the pipe at one point, and its course can then be traced by a man carrying a receiving set and a frame aerial. With properly adjusted apparatus it is possible to pick up signals for a distance of 1 mile on either side of the transmitter. Full particulars of transmitter and of receiver are given. The apparatus may also be used for locating junctions, service connections, etc., and may thus be used to detect illegal tapping of pipe-lines. S. E. C.

1071. Application of Resistivity Measurements in the Roumanian Petroliferous Basin. M. J. J. Breusse. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 717–722.—Since 1933 a continuous area of 2500 sq. km. in the Roumanian petroliferous basin has been examined by means of the direct-current resistivity method. The geological conditions are favourable for this method, for the resistivities of the four divisions of the Pliocene diminish downwards (16 ohms/m. in Levantine to 2 ohms/m. in Meotic). These conditions favour the penetration of the current into the earth, and depths of 1500 m. can be reached with a remarkable sensitivity. Boreholes have borne out the fact that a variation of 1 ohm in the apparent resistivity measured at the surface corresponds, on an average, to a depth variation of 60–70 m. of the top of the Pontic.

Two examples are described in detail in which drilling has shown the validity of the deductions from the resistivity measurements.

The technique has been progressively improved, and an average rate of working of 50 sq. km. per month per set of equipment has been achieved. G. D. H.

1072. Electrical Anisotropy of the Ground and Pseudo-Anisotropy. R. Geneslay and F. Rouget. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 723–731.—The existence of electrical anistropy in rock formations is doubted by none, but some geophysicists are undecided as to its importance and the need of taking it into account in their interpretations. Micro-anisotropy, due to the direction following a special plane of some of the micro-constituents of the rocks, must be distinguished from macro-anisotropy, due to rapid alternations in stratification. Pseudo-anisotropy is applied to the over-all properties of two or more strata of different resistivities and anisotropy, and thicknesses which are small as compared with the spacing of the

measuring devices, when, from the point of view of distribution of potentials at the surface, the effect is the same as that of a single homogeneous, anisotropic formation.

The measurement of anisotropy and its influence on calculations are discussed, and an example is quoted where ignoring its effects leads to an error of 2000 ft. in the depth of a formation which is really at 3000 ft.

In the case of five conducting beds (marls) alternating with five resistant beds (limestones), all of the same thickness, and resting on an indefinite, homogeneous and isotropic substratum of infinite conductivity, it is shown that above a certain length of line, the diagram obtained will be identical with that which would be obtained if a homogeneous anisotropic formation lay on the same substratum. The theory of pseudo-anisotropy is examined mathematically. G. D. H.

1073. Borehole Surveys with High-Frequency Currents. O. Martienssen. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 733–738.—Variations in the dielectric constant of the strata are measured. The capacity of an antenna placed in the borehole varies with the dielectric constant of the adjacent strata. A high-frequency current generated in the borehole will respond to changes in the capacity of the antenna by changes in its frequency. These frequency changes can be measured at the surface. The apparatus is described. It can be used in empty holes or in holes filled with mud or oil. Strata as thin as 10–20 cm. can be detected. A number of examples of measurements made in boreholes is given. S. E. C.

1074. Example of the Application of Schlumberger Electrical Logging to the Study of a Complex Geological Structure. L. Migaux. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 739–746.—Systematic electrical coring has been able to disentangle the rather complicated geological structure of Tselfat (N.E. Morocco). Although no well has penetrated the full section from Upper Toarcian to Middle Domerian, on account of the faults which cause elimination and repetition, comparison of the electrical logs has permitted the compilation of a log for the full series, and afterwards the correlation of the various wells. The structure deduced is shown in a cross-section, and it is noteworthy that the results of electromagnetic measurements of the dip of the beds agree with this section. This points to the value of electrical logging on complex structures and of the method of measuring dips.

A more detailed study of the side-tracking at the bottom of TS 26 shows how the systematic use of electrical logging and the dip-meter facilitates delicate operations which would otherwise have to be carried out in the dark. G. D. H.

1075. Control of the Results Obtained with the Electromagnetic Dip-Meter on a Known Geological Structure. M. Schlumberger and H. G. Doll. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1) 747–750.—Anisotropy is not the only phenomenon which is able to bend the equipotential surfaces according to the dip of the beds. There is also bending due to refraction of the equipotential surfaces at the junction between two beds of different resistivities. This feature can be usefully employed to give a greater accuracy to the dip determinations.

The effectiveness of the apparatus has been tested in five wells drilled on a structure which is geologically well known. The results compare well with the geological data, even in the unfavourable instances where the dips were small—about 5°. The results are shown on a map.

The efficiency of the dip-meter is now well established, and about twenty of the instruments are now being used in various parts of the world. G. D. H.

1076. Application of Schlumberger Electrical Logging in Oilfield Operations. J. H. M. A. Thomeer. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 751–756.—The electrical well-surveying method developed by the Schlumberger brothers about 1928 has gradually become a normal routine operation in almost all the world's oilfields. The growth of the use of this method by the Royal Dutch Shell Group is briefly reviewed. Its chief advantage is the greatly increased possibilities of correct correlation, and thus better structural interpretations are attained. In some cases, it is also possible to form an idea of productivity of reservoir rocks, but such deductions

should be made with caution, and only by those with an extensive knowledge of local conditions.

Schlumberger surveys are now an essential part of modern exploitation methods, and the interpretation of the logs should be part of the routine work of the oil companies' staffs, assisted when necessary by the Schlumberger Company's experts.

G. D. H.

1077. In the Methods of Calculation in Seismic Reflection Prospecting. M. J. Bazerque. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 757–766.—The aim of many geophysical investigations is the determination of the dip of horizons which are sensibly parallel and of which the curvature is not very strong. This can be achieved with considerable numerical exactitude using the seismic reflection method coupled with the idea of a mean velocity of transmission, and a surface indicatrix corresponding to this mean velocity, tangential to the experimental surface indicatrix and capable of merging with it for a moderate distance around the shot-point. This involves the substitution of a hypothetical homogeneous bed for the actual series of beds, and renders practicable and precise the determination of depths and dips. The application is discussed for a single bed with a plane horizontal and a plane inclined reflecting surface, and for a curved reflecting surface; also for a series of parallel beds set horizontally and inclined.

The intercalation of a bed of very different velocity from the other beds is not a source of serious error, provided it does not constitute an important proportion of the total thickness involved.

G. D. H.

1078. Elimination of Systematic Errors in Seismic Reflection Work by the Method of Closed Polygons. G. Bouche. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 767–770.—The use of the seismic reflection method has shown that reflecting horizons are generally very frequent, and that often one of these horizons can be identified and followed from station to station. It is proposed to render the interpretations more exact by using a method employed in topographical surveying—*i.e.*, making measurements along a closed polygon, the last measurement being at the same station as the first. The value of such a method is demonstrated for the following cases: (*a*) where the reflecting horizon is perfectly continuous, (*b*) where it is necessary to follow a hypothetical horizon which satisfies the experimental results. The application of such methods permits the localization of faults and flexures.

G. D. H.

1079. Determination of High Dips by the Seismic Reflection Method. M. Jabiol. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 771–773.—Whilst all other geophysical methods are integral methods which give data concerning underground masses the volumes of which increase with the depth, the seismic reflection method alone is capable of supplying information regarding the surfaces of the geological "mirrors" independent of depth. This quality makes it of great value in the detailed studies of petroliferous structures, and is of special service for giving dips. Consequently it permits the delineation of anticlinal axes.

The idea that the method is only applicable to areas of low dip is shown to be incorrect, and two examples are discussed in which the dips were 28° and 40°. It is also shown that the method can be applied quite satisfactorily even where the observational data are imperfect.

G. D. H.

1080. Seismic Reflection Survey in Eastern England. J. H. Jones. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 775–782.—A seismic reflection traverse has been made in an E.–W. direction across Nottinghamshire and Lincolnshire to delineate the surface of the Carboniferous limestone, the depth of which was known at a point near Kelham. The charge of gelignite was usually exploded below the weathered layer in shot holes drilled to a depth of 50–60 ft. with a portable rotary drill, whilst the six geophones were spaced at 750 ft. intervals at a mean distance of 2000 ft. from the explosion point. A method is outlined whereby the depth and inclination of the reflecting surface can be determined directly from the data obtained from the reflection seismograms.

Correlation of the reflections along the traverse points to the presence of a good reflecting horizon at an average depth of 2800 ft. This corresponds closely with the

depth of the Carboniferous limestone near Kelham, and on this evidence the good reflecting horizon has been identified as the top of the Carboniferous limestone. The reflecting horizon shows only gentle undulations. G. D. H.

1081. Exploration by Seismic Reflection from an Isolated Station. R. Leleu. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 783–785.—Using seismic reflection methods around an isolated hole, it is usual to lay out the seismographs along two lines as nearly as possible at right angles. In general, several shots are fired. If the speed of propagation is supposed known, a study of the observations permits the determination of the depth of the reflecting horizon, and the direction and angle of its inclination. An example is quoted wherein the interpretation is made by a simple graphical method.

The method can be applied in a region which is geologically unknown, for an interpretation is possible independently of any preconceived geological hypothesis, although this entails an enormous number of observations. A little geological information can greatly reduce the uncertainty and expense of such prospecting. G. D. H.

1082. Seismic Methods of Prospecting and their Application in Exploration for Oil in Poland. Z. A. Mitera. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 787–792.—The continued decline of the Polish oil production has rendered the search for new fields imperative. In the Carpathian province the complexity of the structures generally precludes the use of geophysical methods, but in the sub-Carpathian province, conditions are more favourable for their application, especially as the surface deposits hinder ordinary geological work. Some 4000 sq. km. were examined by seismic refraction methods, but the results were not entirely satisfactory, for they failed to delineate tectonic elements and sub-surface structures, although the limits of the Podolian Plateau were defined. The seismic reflection method has been applied with more success. In the Carpathians it has been possible to determine dips, and in a few limited areas to correlate reflections. In the Carpathian foreland conditions are better and excellent reflecting horizons occur. A prominent reflecting horizon has been correlated with gypsum beds in the Miocene and their structure has been studied over an area of 11,000 sq. km. To the end of 1936 only two test wells were drilled in this area, to a depth not exceeding 1500 m. They were not sufficient to prove structural conditions for possible oil reserves, although they yielded valuable geological data. G. D. H.

1083. Some Problems of Applied Seismics. W. v. zur Muehlen. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 793–795.—The physical properties, density and elasticity modulus of a geological horizon vary in different areas, and especially at different depths. Also the horizon in which the velocity suddenly increases seldom coincides with the upper surface of a stratigraphical horizon. Physical properties and stratigraphical correlation need not conform with one another. Thus when depths are calculated directly from seismic surveys the results do not in all cases give the geological structure. It is suggested that the calculation of depths and the construction of depth lines be abandoned, and instead the results should be expressed in terms of times of propagation of the waves. They can then be reinterpreted as the depths of a hypothetical horizon. S. E. C.

1084. Seismic Reflection Method in Germany. F. Trappe. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 797–799.—The reflection method can be used in areas where the differences in characteristics of the strata are insufficient to give an appreciable effect with the refraction method. Thus in the case where the Tertiary rests on the Upper Cretaceous even calcareous horizons in the Lower Tertiary can be picked up by the reflection method. In areas where the Lower Cretaceous outcrops the first reflection is obtained from the bottom Lower Cretaceous and then follow reflections from the calcareous horizons in the Jurassic and still deeper zones. Regional surveys are possible, but certain problems may arise. It is difficult to obtain reflection seismograms of consistently good quality over large areas. The topography, groundwater level, and properties of the surface of the ground all affect the results. In N. Germany it has been found that the presence of peat seriously affects the curves. The application of the reflection method to the discovery of overhang in salt domes is mentioned. S. E. C.

1085. Geophysics has Proved its Importance in California Prospecting. W. A. Sawdon. *Petrol. Engr*, July 1938, **9** (11), 23–24.—Many geophysical parties are operating in California, and amongst them seismic reflection parties are predominant. However, resistivity surveys are also being used to advantage. Frequently when using outside services two companies are called on to report on an area before the site for a test well is selected. G. D. H.

1086. Portability and Speed Feature New Gravimeters. K. Steinmann. *Oil Wkly*, 12.9.38, **91** (1), 58–66.—Gravimeters have been made more portable, sensitive and speedy in action. Now about 200 are in use throughout the world, having replaced torsion balances and pendulums for some purposes. The latest type of torsion balance will give eight readings per day, whereas it has been possible to obtain as many as twenty-five per day with some gravimeters, although the need for the checking of drift by frequent returns to the base station retards the work. The area must be carefully plane-tabled, and the stations marked in advance of the gravimeter party. Ordinarily the instrument is transported by truck, but some can be taken in a car. Many are set on a tripod through holes in the base of the truck, the latter affording some protection from the weather.

The data are reduced to sea-level by correcting for elevation, topography and barometric pressure, and are plotted to give isonomalic lines at intervals of 1 milligal or less. G. D. H.

1087. Field Procedure in Magnetometer Work. K. W. Steinmann. *Oil Wkly*, 11.7.38, **90** (5), 25–28.—The magnetometer, as applied in geophysical prospecting, and the field procedure involved in its use, are briefly described, with photographs illustrating the various points. A map of equal magnetic intensities, and a magnetic anomaly profile, are also given. G. D. H.

1088. Newer Trends and Methods in Geophysical Petroleum Exploration. J. B. Eby. *Petrol. Engr*, Midyear 1938, **9** (10), 31–40.—Examination of the 541 major oilfields found in the period 1922–1936 shows a great preponderance of scientific (geological and geophysical) discoveries over wildcats. If cumulative ultimate production is considered, wildcats lie below geological and above geophysical discoveries, largely due to E. Texas being a wildcat. There is a trend towards deeper drilling.

Eltran anomalies are said to be the electrical expression of the shallow mineralization—hardening or induration of the sediments—which occurs over buried structures. This mineralization is believed to affect the distribution of the hydrocarbon seeps, thus giving rise to "haloes." The Eltran method and its modifications give a measure of the resistivity, using alternating current of known wave form. Spurious anomalies (due to iron pipes, etc.) can be detected.

Soils are assumed to adsorb gases, and their analysis for hydrocarbon gases is increasing in importance. In the laboratory ethane is separated (methane can arise from soil bacteria). Its concentration ranges 0–2 parts per billion of soil. The plotted analyses give two patterns—one long and narrow for fault traces, the other a ring, due, it is supposed, to the fractures over the top of a structure being closed by mineralization, whilst they remain open at the edges. Hence the ring is assumed to be associated with a producing structure, but the relationship between the ethane count and the productivity has not been defined.

The costs of these geophysical methods are examined. G. D. H.

1089. Geophysics Maintains Important Coastal Standing. K. W. Steinmann. *Oil Wkly*, 25.7.38, **90** (7), 114–118.—A recent rough estimate shows that $500,000 were spent in one month on geophysical work on the Gulf Coast, whilst there were 800 men in the field and 200 men in the offices of the geophysical companies. About $600,000 are spent annually on geophysical research in the U.S.A. The cost per acre for geophysical work on the Texas and Louisiana Gulf Coast ranges 4 cents to $2, depending on the method used and the detail required. The rate of working is equally variable.

During 1938 activity on the Louisiana Gulf Coast has increased slightly, but in the coastal area of Texas there has been a slight decrease. In June 1938 in one week on

the Louisiana Gulf Coast there were forty-four seismic reflection parties, ten torsion balance, four gravity meter and three others at work.

Quite a number of discoveries are largely attributable to geophysical work, and there are also undrilled prospects. At Cedar Point all the surveying was done from boats in the shallow waters of Galveston Bay. Torsion balance and seismic reflection methods were used. This is believed to be a faulted structure over a deep-seated salt dome. Geophysics has played an important part in the discovery of Fairbanks, Eureka, Raceland, Timberlier Bay and Creole. G. D. H.

1090. Core Testing by Radioactive Methods. H. Landsberg and A. I. Ingham. *Oil Wkly,* 4.7.38, **90** (4), 26–28.—Radon readily dissolves in petroleum, and this led to the idea of testing the radioactive properties of oil-bearing strata. Radon, being a gas, would be able to diffuse through porous strata, and thus oil might become enriched in it. There disintegration would continue, and the solid products might stay in part in that horizon even if the oil were removed. This secondary concentration of radio-active material, as well as any possible primary differences in radioactive substances in the strata, if measurable, might be of service in correlation.

Cores have therefore been examined for radioactivity. So far the best results were obtained with a Lindemann capillary electrometer. The cores were pulverized to 100-mesh to give a large active surface. Tests revealed appreciable differences in a series of samples taken at 2-ft. intervals in a well. Duplicate determinations showed reasonable agreement. Negative and positive ionization was observed. The former can only be due to a product of radon, Ra D, or possibly due to potassium compounds. No relationship between radioactivity and porosity was traceable off hand.

The possibility of correlation by this method has yet to be demonstrated.

G. D. H.

Drilling.

1091. Drilling Methods for Prospecting in Various Parts of Italy. R. Contini. *II^me Congrès Mond. Pétrole,* 1937, **1** (Sect. 1), 55–70.—Conditions vary greatly in various parts of Italy, and consequently the drilling outfits have to be selected to meet local conditions. The various types of outfit in use, rotary and percussion, are described, and the rotary equipment used for deep drilling (3000 m.) is dealt with in detail. The design of the casing for these deep holes is also considered. S. E. C.

1092. Improvements in Rotary Drilling Equipment since 1933. J. E. Brantly. *II^me Congrès Mond. Pétrole,* 1937, **1** (Sect. 1), 271–284.—The more outstanding advance-ments are outlined, the various items being considered separately and in order from the power plant to the drilling tools. The advances, with the exception of some new feed devices, diesel-electric outfits, etc., have been mainly due to the refinement of established equipment. S. E. C.

1093. Problem of Drilling in the Polish Oilfields. T. Bielski and Z. Szwabowicz. *II^me Congrès Mond. Pétrole,* 1937, **1** (Sect. 1), 803–807.—Cable tool-rigs now occupy the first place for drilling in Poland, having completely displaced the Canadian rigs. They are of two types: heavy rigs for deep wells, and light portable or semi-portable rigs for shallow wells. For deep wells twin-cylindered steam engines with cranks set 90° apart are used. There have been no outstanding changes in the use of electric motors, and internal-combustion engines are only used on isolated wells. The con-struction of the portable and semi-portable drilling outfits is examined critically.

Tapered cables have been used on deep wells to save weight, and thin-walled tubes have been made for drilling in easy territory. Special attention has been paid to rig illumination.

Rotary drilling has been used but little in Poland, and all the rotary rigs have been imported. Directional drilling has been carried out at one location. High efficiency has been achieved in water shut-offs by cementation. G. D. H.

1094. Drilling and Production Methods at Devoli (Albania). P. V. Borgucci. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 809–815.—The main problems at Devoli are due to a large number of producing horizons, each of which is very variable, to the heavy asphaltic oil which is accompanied by small quantities of gas, to the relatively low production of each well, and to the close spacing which is necessitated by the above conditions. These difficulties are being surmounted by the use of electric power throughout the field, by arranging the drilling rigs so that they may be readily moved the short distance from one location to another, and by a system of central mud and cement plants. S. E. C.

1095. Drilling Methods Used in Mexico. A. de la Cueva. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 817–819.—A portable rotary drill with a core barrel has been used for exploratory work. This can be adapted to drill an inclined hole to obtain greater sections of the beds when required. The maximum depth attainable by it is about 300 m. For exploitation cable tools were most widely used for wildcatting, but the rotary drill has largely displaced them for depths of 600 to 2200 m. or even to 3100 m. The cores obtained by the latter method are of great value. Various mechanical improvements and the use of precision instruments have increased the efficiency of the rotary system.

It is suggested that in drilling to great depths a small-diameter (say 15 cm.) hole should first be made and, on encountering favourable indications, enlarged and lined in a standard manner. This would take advantage of the lower cost of drilling a small-diameter hole, but would still give geological data in a case of failure or non-production. G. D. H.

1096. Modern Rotary Drilling Equipment. W. Müller. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 821–827.—A short review of modern rotary drilling equipment, more especially that of European origin. S. E. C.

1097. Modern Rotary Drives. H. Schimmel. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 829–836.—A short review of modern steam, diesel, diesel-electric, and electric drives is given from the point of view of helping the driller to choose his source of power. There is insufficient contact between field engineers and engine-builders, and in consequence the ideal drive for the rotary rig has not yet been evolved. This work should be taken in hand at once by the various standardization committees such as the A.P.I. S. E. C.

1098. Division of Energy in a Rotary Well. Leca and Jaussaud. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 837–843.—Detailed measurements of the power consumption of various parts of a rotary rig were made on wells in Morocco. The results of these observations are divided into three groups, hoisting operations, the rotary drive and the pumps. It is shown that the energy consumed by transmission chains is relatively small. The efficiency of the draw-works is of the order of 70%, that of the pump system 40–60%, whilst that of the rotary drive is only 10–20%. Drilling speed is directly proportional to the pump delivery when the upward velocity of the mud in the annular space between the walls of the hole and the drill collar is 12–30 m. per min. Economies of as much as 10% could be effected by providing separate motors for hoisting, pumps, and the rotary table. S. E. C.

1099. Rotary Installation Driven by Diesel Engines Provided with Hydraulic Couplings. H. M. Hohmann. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 845–852.—After obtaining experience in the use of a direct diesel-driven drilling rig on one of their fields, the Royal Dutch Shell decided to use higher speed light diesel engines on an isolated exploratory location in the Dutch East Indies. All clutches requiring engagement while running were of the friction type; the engines were capable of wide speed regulation and were fitted with hydraulic couplings permitting 100% slip during a period of 10–15 mins., which is a desirable feature for pulling for instance on a frozen fish. The first outfit worked very satisfactorily, but the need for further improvements, especially greater flexibility, was felt.

The second outfit was therefore equipped with two engines fitted with Vulcan Sinclair hydraulic couplings, with a ring valve coupled to the fuel control in such a way that at idling speed (250 r.p.m.) the valve was closed, whilst at 350 r.p.m. it was wide open. The countershafts were equipped with disc type friction clutches and the pumps were driven by V-belt drives. By using a two post three shaft draw-works the number of chains running when drilling was reduced from eight to two. The main draw-works friction clutch and the reversing gear were operated by oil pressure from a gear pump driven from the end of the countershaft, and the controls were so arranged that it was possible to regulate them as well as either engine separately or both engines together from the driller's position in the derrick. The drilling outfit was entirely self-contained including diesel-driven auxiliary plant for electrical current, a mud mixing plant complete with pumps, a pump for high-pressure water for cementing operations and electrically driven centrifugal pumps for water supply.

Some data on fuel consumption, running and maintenance costs are given.

G. D. H.

1100. Fluid Couplings and their Application to Oilfield Equipment. L. S. Dawson. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 853–864.—Hydraulic couplings have been usefully applied to draw-works and slush-pump drives. The installations have been almost exclusively on diesel-engine-driven rigs. Tests have shown that they are very efficient in damping out torsional vibrations. A slush pump driven by a diesel engine with a fluid coupling approaches the characteristics of a steam-driven pump.

A gear-box with constant mesh gears and baulking rings is described in detail. The sliding dogs are actuated by a pneumatic cylinder.

By combining an electric motor and a fluid coupling of suitably matched characteristics, it is possible to avoid the disadvantages of the direct-coupled A.-C. machine, particularly as regards stalling and overloads. G. D. H.

1101. Rôle and Optimum Weight of the Drill Collar. I. Basgan. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1) 865–867. A formula is developed whereby the optimum weight of the drill collar under various conditions of drilling may be calculated. The value of the formula has been proved by practical tests. S. E. C.

1102. Apparatus for Recording Vertical Movements of the Drilling String. M. Debregeas. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 875–876.—It has long been the custom to fit apparatus which records the tension in the cable supporting the drilling string, but this fails to supply much information which is of value. A simple device is described which, by registering the angular movements of the winding drum, gives a record of the movements of the hook with respect to time, and hence of the rate of drilling advance, the times and distances of redrilling, times of pulling out, etc. An angular scale permits the rates of drilling to be read off easily from this very useful log. G. D. H.

1103. Increasing the Life of Drilling Cables. Debregeas and Cheysson. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1) 877–880.—The greatest wear on a cable is only over a relatively short section of its length. If a cable could be moved at intervals so that the wear was more evenly distributed, its life would be greatly increased. A device for attaining this end is described. S. E. C.

1104. Thixotropy of Mud Fluid. A Reid. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 883–888.—All treated muds and many untreated muds show thixotropic characteristics, and, furthermore, these properties may in certain cases be induced even in relatively coarse suspensions. A sodium bentonite mud is markedly thixotropic. Care must be taken not to confuse thixotropy with the slow increase in viscosity with time which is shown by many muds. Where both are found, great care must be taken in the interpretation of viscosity measurements. Thixotropy is difficult to measure, and there are no satisfactory units. Experimental methods are discussed. From the point of view of drilling muds thixotropy has a number of advantages and

disadvantages, and close control is necessary in order that the advantages are not outbalanced. The problem is rendered more difficult by the fact that the alkalis commonly added to reduce viscosity also tend to increase thixotropy. Some method of controlling this increase is needed, and research on those lines is being conducted. An associated phenomenon is rheopexy, a property whereby orientation of particles, rod or plate-like in shape, affects the rate of gelation. Rheopectic suspensions of bentonites have been prepared, and the problem then arises whether rheopexy has any important bearing on the properties of drilling muds. S. E. C.

1105. Theory of Base Exchange and its Application to Drilling Muds. A. K. Montgomerie. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 889–894.—After summarizing modern views of the structure of clays and the general nature of base exchange reactions, the paper indicates the way in which the exchangeable bases of the clay or shale in muds influence the properties of the muds. A knowledge of the exchangeable bases is useful for indicating preliminary treatment likely to improve the mud-making qualities of the raw material, and in predicting the effect of reagents on the muds. Base-exchange reactions may be especially important in problems associated with heaving shales. G. D. H.

1106. Internal Structure of Drilling Muds. Didier. *II^me Congrès Mond. Pétrole* 1937, **1** (Sect. 1), 895–900.—The variable characteristics and their apparent independence of the superficial appearance of a mud are due to its heterogeneous constitution. Drilling muds consist of water, dissolved salts, and solid suspended matter. The chemical analysis of a mud is of little help in assessing its properties, since very different muds have more or less similar chemical compositions. The factors which are significant are the amount of water present, the physical dimensions and nature of the solid constituents, the electrical properties of the suspension, and the nature of the dissolved salts. S. E. C.

1107. Work of Drilling Muds. Didier. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 901–909.—The paper is limited to the discussion of the normal work of mud during drilling. Special circumstances, as when approaching oil and gas horizons, are not considered. The two most important functions of the mud are to clear away the debris made by the drilling bit and to maintain the walls of the hole. In the first case the upward velocity of the mud in the well must be greater than the falling velocity of the largest particles to be removed. In normal cases this velocity should be at least of the order of 20 cm. per sec. Removal of the debris from the mud at the surface involves screening and sedimentation, both of which are discussed. The chief difficulties in maintaining the walls of the hole are due to crumbling, which may be purely mechanical or may be the result of chemical action (cf. action of $MgSO_4$ on clays), and to swelling. In all these cases free water is the chief agent, and the mud must therefore be prepared so as to avoid this danger. The properties of an ideal mud and its reconditioning are then briefly discussed. S. E. C.

1108. Supervision of Drilling Muds. Didier. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 911–917.—The usual measurements of density and viscosity are insufficient. Laboratory control should include mechanical analyses, measurement of free water—for which purpose an eleuthimeter is described—p_H measurements, and density, viscosity, and rigidity determinations. The results of this examination may be expressed graphically to aid in comparison. Laboratory control should be supplemented by daily examinations on the field. S. E. C.

1109. Utilization of Natural Rocks for Drilling Muds. A. Comet. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 919–922.—The conditions generally required for a drilling mud are satisfied when one obtains a colloidal fluid with thixotropic properties. As a guide to the attainment of the desired state various physical properties, such as viscosity, density, p_H value, etc., are measured. Certain clays which disperse readily in water and give relatively stable suspensions make good muds, and thixotropic properties can be induced by the addition of such materials as sodium silicate.

It was found that many of the marls at Pechelbronn made good muds when mixed with water or with dilute solutions of various salts. S. E. C.

1110. Treatment of Mud with Sodium Silicate in Order to Maintain the Walls of the Well. M. Debregeas. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 923–928.—The use of sodium silicate in muds when drilling in Morocco has enabled certain drilling difficulties to be overcome, and would probably have avoided some if the silicate had been added sufficiently early. These troubles with the sides of the hole appear to be due to the presence of too much free water or too little colloidal matter. Typical troubles encountered in porous formations are loss of circulation when cavities occur, and the formation of clogging filter cakes in ordinary circumstances. Where the formations disintegrate in contact with free water, caving may occur, with the possibility of freezing the bit, giving projections on the walls, and entailing much redrilling The addition of sodium silicate to the mud has made it possible to overcome these difficulties, although the action may be slow if the trouble is allowed to attain an advanced form. G. D. H.

1111. Design of the Mud System. Debregeas, Leca, and Bernadac. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 929–931.—The mud system in use in Morocco is described. The mud flows from the well on to a vibrating screen and then passes into three metal tanks. These tanks are arranged in parallel, so that one may be cleaned out at any time without interrupting the flow of mud in the well. S. E. C.

1112. Art of Oil-well Surveying and Controlled Directional Drilling. H. J. Eastman. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 933–942.—There are three main types of continuous recording survey instruments: gyroscopic, drill-pipe orientation, and magnetic. The gyroscopic type has the advantages of working in cased and uncased holes and of being unaffected by torsion or magnetism, but it has the disadvantages of being expensive, very delicate, and too large to run safely in 6-in. casing. Drill-pipe orientation is a relatively cheap method, and can be used in small cased or uncased holes, but it involves running the drill-pipe, there is no check on closure, and in deep wells torsion may cause errors. The magnetic type has the advantages of the drill-pipe orientation method, but cannot be used in cased holes except in conjunction with that method.

A simple "single-shot" magnetic instrument has now been designed which can be operated by the drilling crew, and one model can be used with the wire-line coring equipment.

Doubts have been cast on the accuracy of the magnetic instruments, but check surveys with other types of instrument have agreed very satisfactorily.

Controlled directional drilling was made practicable by the introduction of the removable whipstock and its use in conjunction with the single-shot survey instrument. Wells which have been drilled at high drift angles can be pumped providing the deflection was carefully done and the oil itself is a reasonable lubricant. Examples of the use of controlled directional drilling are given. S. E. C.

1113. Drilling for Oil and Gas in Dolomite and Limestone. H. Wolff. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 943–953.—The geology, drilling methods, casing programs, production, and any special problems and methods in three typical limestone fields are described. The fields are Thuringia (Germany), Poza Rica (Mexico), and Yates Pool (Texas). The problem in Thuringia is to increase the production from the dolomite, and shooting and acid treatment, of which particulars are given, have been tried, but so far with little success. In the Poza Rica field any difficulties which arise are due mainly to the depth of the producing horizon, the high gas pressure, and the problem of transporting heavy gear to the field. The main problem in the Yates Pool is to regulate drilling and production so that the maximum total recovery will be attained. S. E. C.

1114. Heat Conservation in Steam-Drilling Plant. C. Talbot-Longcroft. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 955–966.—The assertion that heat-conser-

vation methods as applied in stationary steam plants are not practicable in portable drilling plant is not warranted. The fundamental principles of these methods may still be applied without sacrificing portability and simplicity. The main directions in which economies may be effected are preheating of feed-water, increasing the yield and pressure of the boilers, superheating, by using power pumps instead of direct-acting pumps, using a separate small engine for the rotary drive, and by insulation of boilers and steam lines. These points are discussed, and a number of examples are given of the economies effected in various plants. S. E. C.

1115. Specifications for Oil-Well Cement. R. J. Forbes. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 967–971.—The special requirements of modern drilling and the present position of the cement market have made it necessary to draw up definite specifications for oil-well cement. Test-pieces should be made of neat cement mixed in different water–cement ratios, and it is important that tests should be made at different temperatures. The properties to be specified comprise: (1) Sieve residue on specified sieves. (2) Soundness at 200° C. by Le Chatelier and Michaelis' method. (3) Initial set at 50° and 90° C. for water–cement ratios of 0·4 and 0·6. (4) Compressive strength and tensile strength after 3, 10, and 28 days at room temperature, 50° and 90° C., for water–cement ratios of 0·4 and 0·6.

It is also desirable that methods should be evolved for determining quickly and accurately the rheological properties of cement slurries and the resistance of hardened cement to the action of oil-well waters. G. D. H.

1116. Freeing a Drill String Jammed in Calcareous Rocks by Injection of Acid. Lassauze and Debregeas. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 1017–1018.—A string of tools was fixed in a calcareous horizon, and normal methods did not free them, although circulation was maintained. The mud was therefore replaced by water and commercial hydrochloric acid pumped in, followed by sufficient water to place the acid in the bottom 200 m. of the well. The well was closed and the drill-pipe held under a tension of 70 tons. After 38 hours the pressure in the well rose to 56 kg. per sq. cm., and it was then allowed to fall off. When it had fallen to 35 kg. per sq. cm. circulation with mud was started and the tools were easily pulled out. S. E. C.

1117. Well Depth Measurements. Part III. C. E. Reistle, Jr., and S. I. Sykes, Jr. *Oil Wkly*, 27/6/38, **90** (3), 50.—This is the concluding article in this series, and deals with special measuring devices and summarizes the results of the study of the well-depth measuring problem. L. V. W. C.

1118. Multiple Zone Producing Practices at Wilmington. B. Mills. *Oil Wkly*, 27.6.38, **90** (3), 44.—Outstanding achievements in the congested Wilmington field are the continuous production of two and three separate zones through a common Christmas tree, deviated drilling to develop industrial property and lack of pollution in connection with severe drilling requirements.

The application of geophysics to the area gave data that indicated the existence of a promising structure. Three main zones have been developed. Directional drilling has probably reached its most advanced stage in this field.

Simultaneous production of two and three zones through a common Christmas tree has placed the Wilmington field in a unique position. Sand has caused considerable trouble, and the recent practice has been to place 12 1-in. round holes in the 5-in. flow-string just above the packer used for separating the flow from the two zones. The oil is thus forced to enter the annular space between the 5-in. flow-string and the tubing, and in so doing flushes out the sand.

One-third of the wells are on the pump. L. V. W. C.

1119. Turbo Drill—A Development that may Lead to Changes in Present Drilling Practice. W. A. Sawdon. *Petrol. Engr*, June 1938, **9** (9), 35.—The turbo drill, now in operation in California, is a turbine-driven bit operated by the mud fluid. The power is developed at the bottom of the hole, and no rotation of the drill-pipe occurs

the pipe merely acting as a conduit for the mud fluid, and providing weight control.

The results obtained prove the adaptability of the submerged turbine assembly for deep-well drilling. Higher speeds are possible, and reduced torsional stress in the drill-pipe results because of the drill-stem being stationary while drilling.

The drill is an improvement on the Capelushnikov turbine drill which has been in use for a number of years in Russia. The Capelushnikov drill is equipped with a speed-reduction device, and has been used only in shallow holes, whereas the one described has no such device, and has been proved out in two wells below 4000 ft.

L. V. W. C.

1120. High-Pressure Pump Designed for Cementing Operations. W. D. Owsley. *Petrol. Engr*, June 1938, **9** (9), 37.—Increases in operating pressures resulting from the development of deeper fields having correspondingly higher pressures and a steady trend towards the use of power other than steam have caused a demand for power-driven equipment for such operations as oil-well cementing, high-pressure circulating, well-killing and portable rotary-drilling operations.

A new pump has been developed for oil-well cementing operations. This pump is duplex, double-acting and has a 10-in. stroke. It is equipped with 4½-in. pistons with a maximum piston size of 5 in. As designed the pump has a working pressure of 4500 lb. per sq. in. when equipped with 5-in. pistons and 6000 lb. per sq. in. with 4½-in.

When driven by 110-h.p. gasoline engine through transmission and power take off the volumetric capacity ranges from 360 brl. per hour at 100 r.p.m. to 44 brl. per hour at 6000 lb. using 4½-in. pistons.

L. V. W. C.

1121. Wells Drilled Through Mine Tunnels Present Unusual Cementing Problem. W. A. Sawdon. *Petrol. Engr*, June 1938, **9** (9), 54.—In some locations in the Centralia district in Illinois well-bores have passed through mine tunnels that lead into mines that are being worked. The law requires all operators drilling into shafts or tunnels to cement casing from the roof to the surface of the ground and then drill 75 ft. below the floor of the tunnel and cement another string of pipe. One string of casing can be saved by cementing in two stages. The lower cement job is completed first and a 4½-in. loaded ball is dropped into the seat of a bridging collar which is placed in the casing string just above the roof of the tunnel. A cement basket is also located at this point, and the second cement job can be carried out.

L. V. W. C.

1122. Drilling Patents. R. C. Baker. U.S.P. 2,121,002, 21.6.38. Cement retainer and bridge plug for well casings.

T. M. Rogan and C. E. Burt. U.S.P. 2,121,050 and 2,121,051, 21.6.38. Hydraulically controlled cement retainer.

J. A. Elmes. U.S.P. 2,121,078, 21.6.38. A drilling machine comprising a frame carrying a spudding mechanism having a vertically movable crown, sheave slide and hydraulic shock-absorber to retard the action of a spring interposed between the crown sheave slide and the derrick.

J. A. Zublin. U.S.P. 2,121,112, 21.6.38. Means for circulating fluid around drilling bits.

B. S. Miner. U.S.P. 2,121,256, 21.6.38. Sheave block construction.

D. U. Shaffer. U.S.P. 2,121,267, 21.6.38. Rotary straight pull for assembly.

H. C. Smith. U.S.P. 2,121,888, 28.6.38. Under reamer.

J. S. Beck. U.S.P. 2,122,602, 5.7.38. Rotary automatic catch trip socket.

C. M. Potter, U.S.P. 2,122,697, 5.7.38. An instrument-carrier adapted to be pumped down drill-pipe with circulating fluid.

D. Hanes. U.S.P. 2,122,742, 5.7.38. Cement retaining assembly adapted for use in a " squeeze job " of oil-well cementing.

O. L. Morrisett. U.S.P. 2,122,749, 5.7.38. Packer for oil wells adapted for use as a cement retainer.

J. T. Phipps. U.S.P. 2,122,751, 5.7.38. Fishing jar.

P. M. Rohrbaugh. U.S.P. 2,122,754, 5.7.38. Packer for use as a cement retainer.

F. L. Scott. U.S.P. 2,122,757, 5.7.38. Drill-stem coupling.

F. L. Scott. U.S.P. 2,122,758 and 2,122,759, 5.7.38. Roller-drill cutters.

F. L. Scott and R. P. Sherman. U.S.P. 2,122,760, 5.7.38. Yieldable pipe-wrench.

F. C. Smith. U.S.P. 2,122,763, 5.7.38. Reamer mounting.

R. B. Grainger. U.S.P. 2,122,771, 5.7.38. Core catcher.

J. H. Howard and A. C. Catland. U.S.P. 2,122,863, 5.7.38. Reamer.

J. F. Bozeman. U.S.P. 2,123,036, 5.7.38. Releasable fishing tool.

O. B. Goldman. U.S.P. 2,124,414, 18.7.38. Well drilling-bit of tapered form with the main bit rotating about the axis of the drill-stem and roller elements rotating about axes alternately oppositely offset laterally from and inclined downwardly convergent towards the major axis. The roller elements taper downwardly, the lowermost element terminating in an apex coincident with the major axis.

F. Wintermute. U.S.P. 2,124,663, 26.7.38. Hydraulically operated rotary under-reamer.

G. F. Fermier and J. C. Stokes. U.S.P. 2,124,692, 26.7.38. Spring loaded casing-hook with dashpot to retard, without restricting substantially, downward movement of the hook whilst permitting substantially free upward movement.

W. J. Flury. U.S.P. 2,124,772, 26.7.38. Water circulating fishing-tool.

C. R. Nichols. U.S.P. 2,124,892, 26.7.38. A well-surveying device comprising a mirror arranged to maintain a reflecting surface in constant relation to the vertical, two series of indicia fixed relatively to the casing and means for illuminating both series. Means also for photographing the first-mentioned indicia by reflection from the mirror and the second indicia directly to form superposed records of both.

W. R. Guiberson and A. Pranger. U.S.P. 2,126,007, 9.8.38. Rotating blow-out preventer.

C. E. Reed. U.S.P. 2,126,034, 2,126,035, 2,126,036, 2,126,038, 2,126,039, 2,126,040, and 2,126,041, 9.8.38. Roller cutter bit spindle and bearing assembly.

C. E. Reed. U.S.P. 2,126,037, 9.8.38. Reamer cutter.

J. C. Wright. U.S.P. 2,126,075, 9.8.38. Drill-collar.

J. A. Zublin. U.S.P. 2,126,079, 9.8.38. Rolling disc bit.

H. C. Smith. U.S.P. 2,126,145 and 2,126,146, 9.8.38. Under-reamer and cutter.

M. L. Black. U.S.P. 2,126,241, 9.8.38. Rotary jar.

H. C. W. Miller. U.S.P. 2,126,405, 9.8.38. Protective device for drill-pipes comprising a sectional ring of wear-resisting material adapted to embrace the pipe.

J. W. Culbertson. U.S.P. 2,126,740, 16.8.38. Drift-recording apparatus.

J. W. Culbertson, U.S.P. 2,126,741, 16.8.38. A shock dissipating spear for drift-recording apparatus.

J. R. Yancey. U.S.P. 2,126,857, 16.8.38. Pipe coupling.

F. Stone and A. L. Stone. U.S.P. 2,126,932, 16.8.38. Well-drilling equipment comprising a wedge-slip assembly operated by a snubbing yoke and means for releasing the pipe-gripping elements. L. V. W. C.

Production.

1123. Core Analysis Application to Well Completion. J. H. Campbell and J. A. Lewis. *Oil Wkly*, 25.7.38, **90** (7), 45.—The successful application of core analysis to the completion of flush wells is of recent development. The manner in which cores are taken permits an alteration in the original fluid content, and this makes interpretation of the results more difficult. Water from the drilling mud enters the core, increases the normal saturation and displaces oil and gas. The reduction in pressure as the core is brought to the surface permits the previous fluid content to be disturbed. Thus the estimation of the oil content of the core gives only the residual content that would be present in the reservoir after the latter has been subjected to similar methods of depletion as was the core.

In order that the analysis should be as accurate as possible, the work must be performed on location. New analysis methods have been developed and complete laboratory equipment has been incorporated in bodies specially designed and built for the requirements. Results are obtained, and the analyst endeavours to calculate back to the volume of fluids that are present in the formation before being cored.

It is possible in certain areas to estimate the initial production of wells. This gives an index to the proper size of pumping equipment that should be used. The controlling factor in the placing of shots in a well is the permeability distribution and an attempt at equalization of flow rates will be found to possess other desirable features when the injection of gas and water into the formation is considered. L. V. W. C.

1124. Cementing of Wells in E. Texas Field to Reduce Volume of Water Produced. R. H. King. *Petrol. Engr*, June 1938, **9** (9), 56.—Water constitutes as much as 98% of the fluid produced by some wells in the E. Texas field. Some operators plug back every well producing as much as 15% of water, but this is not general, as there is no assurance that plugs introduced at low pressures will be satisfactory, and the casing in most wells is so poor that it will not stand when a reasonable pressure is exerted on it.

Several theories have been suggested to explain the reason why in many wells several hundred sacks of cement can be introduced without developing the desired pressure, and two methods of operation are being tried.

One theory is that a small batch of cement introduced at a relatively low pressure will enter the largest channels and will, if allowed to set, close them against the entry of any batch introduced later. Batches subsequently introduced will effectually block the smaller channels, and so exclude the water.

The other theory is that gel-forming material mixed with the cement and allowed to set after penetrating the larger channels will prevent further flow of cement in the large channels, and as a result the slurry will be forced into all pores sealing off the water. L. V. W. C.

1125. Automatic Circuit Breakers Used for Controlling Pumping-Well Motors. C. A. Montgomery. *Oil Wkly*, 27.6.39, **90** (3), 40.—Small automatic air-circuit breakers which lend themselves readily to various combinations and assembly into compact units are being used in California to control motors for pumping and servicing oil wells.

These circuit breakers show certain economies in expense in replacing fuses, in loss of production due to blown fuses, and in loss of time by well-pulling crews due to blown fuses in cases where portable electric hoists are used. They have high current interrupting capacity and provide adequate protection for wiring and motor equipment. They are foolproof, in that they cannot be held close against an overload.
L. V. W. C.

1126. Production Patents. L. A. Layne, A. L. Ross and H. C. Block. U.S.P. 2,120,981, 21.6.38. Screw-off packer.

L. A. Layne. U.S.P. 2,120,982, 21.6.38. Lead seal liner packer.

L. A. Layne. U.S.P. 2,120,983, 21.6.38. Wire-wrapped strainer for wells.

T. S. Park. U.S.P. 2,120,988, 21.6.38. Well-strainer washing tool.

I. S. Salnikar. U.S.P. 2,120,991, 21.6.38. Pressure gauge for bottom-hole pressure.

D. U. Shaffer. U.S.P. 2,121,268, 21.6.38. Valve for well-testing tool.

A. B. Case. U.S.P. 2,121,216, 21.6.38. Means for closing a valve in the fuel-supply line of a reciprocating-pump outfit in case of emergency.

G. A. Humason. U.S.P. 2,121,634, 28.6.38. Pipe-pulling spear.

J. E. Culbertson. U.S.P. 2,122,026, 28.6.38. Shock absorber for drift-recording instruments.

G. P. Wisdom, U.S.P. 2,122,080, 28.6.38. Automatic well-flow control comprising a fluid choke and a valve provided with spiral ribs below the choke. The ribs are exposed to the upward flow of liquid to lift the valve an extent corresponding to the velocity of the liquid, thereby partly closing the choke.

C. E. Clason. U.S.P. 2,122,452, 5.7.38. A method of treating oil-bearing formations, firstly by means of an agent capable of reacting to form a salt, then supplying a substance capable of forming an oil-soluble precipitate with the salt, and finally bringing oil in contact with the precipitate to dissolve the plug formed and removing the resultant fluids from the well.

H. P. Wickersham and E. Burns, U.S.P. 2,122,827, 5.7.38. Tubing head.

R. C. Johnston. U.S.P. 2,122,944, 5.7.38. Polish-rod hanger.

E. C. Ekstromer. U.S.P. 2,123,183, 12.7.38. A pumping mechanism comprising a series of motors suspended in the well and power-transferring mechanism having a member to which reciprocating movement is transmitted.

E. C. Ekstromer. U.S.P. 2,123,184, 12.7.38. Motion converting mechanism for pump.

W. L. Church. U.S.P. 2,123,500, 12.7.38. Packer and setting tool.

C. C. Brown. U.S.P. 2,123,930, 19.7.38. A back-off setting device comprising a strainer, a liner and a wash-pipe.

F. Stone and A. L. Stone. U.S.P. 2,124,015, 19.7.38. Packing head.

R. H. Greenawalt. U.S.P. 2,124,617, 26.7.38. Casing Cutter.

E. H. Cox. U.S.P. 2,124,766, 26.7.38. Means for testing the productivity of wells comprising a string of pipe with a chamber, normally closed, at its lower end, but adapted to be opened to receive a sample of the well fluid.

J. B. Wrigley. U.S.P. 2,124,840, 26.7.38. Casing head.

D. Hanes. U.S.P. 2,125,159, 26.7.38. Apparatus for testing wells including taking samples and recording the maximum temperature encountered in the formation.

G. Hurst. U.S.P. 2,125,231, 26.7.38. Packer for oil wells.

F. A. Denker. U.S.P. 2,125,429, 2.8.38. A method for treating calcareous formations with aqueous hydrochloric acid, together with an agent selected from the group consisting of phenol, cresols and xylenols.

H. W. McCune. U.S.P. 2,125,643, 2.8.38. Bailer bottom.

C. E. Wheeler. U.S.P. 2,125,762, 2.8.38. Oil or gas well snuffer.

J. R. Yancey. U.S.P. 2,126,856, 16.8.38. Straight-line needle valve.

R. U. Grant. U.S.P. 2,127,168, 16.8.38. Hydraulically operated deep-well pump.

L. M. C. Seamark. U.S.P. 2,127,312, 16.8.38. Casing-head equipment for boreholes. L. V. W. C.

Crude Petroleum.

1127. Patents on Crude Oil. I. M. Colbeth. U.S.P. 2,122,976, 5.7.38. Demulsifying agent for emulsions of the water in oil type consisting of blown fatty oil which has been treated with butyl alcohol which replaces OH groups of carboxyls.

R. J. Dearborn. U.S.P. 2,124,514, 19.7.38. Stabilization of crude oil prior to its transportation through pipe-lines by subjecting the normally gaseous hydrocarbons to polymerization, removing the normally liquid hydrocarbons formed and adding them to the stabilized crude. W. S. E. C.

Gas.

1128. Patents on Gas. W. J. Podbielniak. U.S.P. 2,123,799, 12.7.38. Tube for use in the heat treatment of gas consisting of an alloy of 68–80% Ni or Co, 17–20% Cr, and 15–0% Fe. W. S. E. C.

Cracking.

1129. Patents on Cracking. E. W. Gard. U.S.P. 2,122,881, 5.7.38. Cracking of hydrocarbon oil in which the vapour generated from an oil prior to cracking is dried.

R. Winkler. U.S.P. 2,122,903, 5.7.38. Catalytic cracking of hydrocarbon oil using 0·02–1% of a catalyst from the class consisting of Ni or Mo and 0·07–0·7% of an organic halogen compound which is capable of splitting off halogen or halogen hydrides under the working conditions.

M. R. Mandelbaum. U.S.P. 2,123,194, 12.7.38. Refining of the cracked distillates by passing them in the vapour phase through an adsorbent catalytic substance.

H. V. Atwell. U.S.P. 2,125,234, 26.7.38. Cracking of hydrocarbon oils to produce incondensable gases and cycle stock. These are maintained in contact with one another at catalytic cracking temperature of 700° F. and under 200 lb./sq. in. pressure in the presence of a metallic halide catalyst to effect conversion without hydrogenation. An intermediate product of the conversion relatively free from catalyst is cracked to form lighter products from which a gasoline distillate is recovered. W. S. E. C.

Hydrogenation.

1130. Catalytic Hydrogenation of Carbon Disulphide at Normal and High Pressures. F. Fischer and H. Koch. *BrennstChemie*, 1.7.38, **19** (13), 245–249.—Catalytic hydrogenation of CO yields higher hydrocarbons, but similar treatment gives no result with CO_2. The present investigations were made to ascertain the type of reaction of CS_2, the S-analogue of CO_2.

At normal pressure the reaction was investigated with a cobalt catalyst in the temperature range between 170 and 350° C. At 250° C. a gas mixture containing $1CS_2 + 3H_2$ was practically completely transformed, yielding hydrogen sulphide, methanethiol, and dimethylic sulphide, the two latter compounds being formed in a ratio of 3 : 1. A higher rate of transformation of CS_2 into methane was observed at temperatures of 300–350° C., and the effects of temperature, excess of hydrogen and rate of flow were investigated. In no case was carbon formation observed.

The hydrogenation of CS_2 under pressure occurred in the presence of a molybdenum sulphide catalyst, with a mixture ratio of $1CS_2 : 3H_2$ at about 190° C. The reaction

was very violent, mainly methane being formed. With a deficiency of hydrogen, at temperatures varying from 200 to 225° C. a moderate hydrogenation occurred with formation of organic S compounds. Small quantities of trithioformaldehyde could be detected. L. R.

1131. Patents on Hydrogenation. C. L. Brown. U.S.P. 2,123,623, 12.7.38. Preparation of molybdenum sulphide catalyst for hydrogenation processes. W. S. E. C.

See also Abstract No. 1182.

Polymerization.

1132. Polymerization Reactions (as Applied to the Preparation of Super Fuels and Lubricants). Ch. Berthelot. *Chim. et Ind.*, 1938, **39**, 835–850.—This is a review of the polymerization processes available to-day for preparing aviation fuels of high octane value, and also of methods for manufacturing lubricating oils from olefines. The theory of polymerization processes and the effect of catalysts are discussed.

Three industrial processes worked in the U.S.A. by Phillips Petroleum Co., Pure Oil Co., and Universal Oil Products are described. D. L. S.

1133. Thermal Catalysis of Carbon Monoxide and Hydrogen. A. H. Nissan. *Oil Gas J.*, 21.7.38, **37** (10), 49.—Synthetic production of a variety of hydrocarbons, alcohols, aldehydes and fatty acids is possible by thermal catalysis of the two gases. The economic value and technical applications of the potential products are discussed. Methods utilized for the production of hydrocarbons fall into two categories: (*a*) high-pressure catalysis, (*b*) atmospheric or low-pressure catalysis. Methane is generally produced by the former method, and an historical survey is given of developments since the Sabatier patent in 1905. More recently, sulphur-resisting molybdenum catalysts have been reported to provide good conversions. The Fischer–Tropsch process (atmospheric pressure) yields gasoline of smooth boiling-point curve but low octane number (47–62). The octane rating can be improved by addition of alcohol, T.E.L., etc., or by reforming or isomerization. The diesel oil produced is of excellent ignition quality suitable for high-speed C.I. engines, and can also be cracked to yield gasoline of high anti-knock value. Both gasoline and diesel oil are practically sulphur-free. Lubricating oils obtained synthetically from the olefinic fractions of primary product of the Fischer–Tropsch process are characterized by low sp. gr. and Conradson coke value and high resistance to oxidation. Developments in the synthesis of methanol are described. A zinc–chromium catalyst containing 75 atomic proportions of zinc has been found the most efficient, the reaction taking place at a pressure of 150–200 atmospheres, and at a temperature of 350–400° C. using water gas subjected to electrolytic hydrogen process so as to give the ratio $1CO : 2H_2$. Sulphur must be rigorously removed, and all volatile compounds, particularly the carbonyl of iron, nickel and cobalt, eliminated and prevented from being formed in the system. The results of various investigators on the production of higher alcohols from the two gases are summarized, together with theories advanced to explain the mechanism of the reactions involved. The addition of 15% rubidium oxide to a chromium oxide–manganese oxide catalyst has been found by Morgan to give the greatest yield of higher alcohols. R. A. E.

1134. Thermal Catalysis of Carbon Monoxide and Hydrogen. Part II. A. H. Nissan. *Oil Gas J.*, 28.7.38, **37** (11), 89.—Fischer discovered that the "oxygenated-hydrocarbon" fraction decreased with decrease in pressure, accompanied by slowing down of the rate of reaction. Search was instituted for catalysts which would accelerate combination but keep the proportion of oxygenated products low, and in 1925 Fischer and Tropsch found that water gas could be converted into hydrocarbons at 200–270° C. under 1 atmosphere pressure and in the presence of catalysts containing iron or cobalt. With iron and an optimum temperature of 250° C. the reactions followed: $2CO + H_2 = (CH_2) + CO_2$ (*a*), whereas with cobalt, control of temperature in the region of 190° C. was necessary and the reactions followed: $CO + 2H_2 = (CH_2) + H_2O$ (*b*). A table shows the yields of Kogasin per cubic metre of gas obtainable with the aid of

various catalysts, and the period of service obtainable from each before conversion rate falls to 80% of the initial rate. Cobalt–therium–kieselguhr is probably the most active catalyst yet found. It is prepared by precipitating the oxides on kieselguhr and reducing with hydrogen. It gives 110 gm. of liquid hydrocarbon per cubic metre of gas, the yield falling by 20% in 60 days due to wax accumulation on the surface area. Other observations on catalysts and addition products are summarized. Various theories advanced to explain the mechanism of the reactions involved are summarized and discussed.

Application of the process to the technical scale proved difficult. Requirements in respect of $CO : H_2$ ratio, removal of sulphur from feed and catalyst preparation have already been briefly described. It is essential to maintain close temperature control (190° C. ± 5° C.) in the reaction chamber. Since the reacting gases evolve about 20% of their total calorific value when the exothermal chemical changes take place, rectangular reaction chambers of small cross-section (2 × 12 cm.) and 5 m. long were designed, and the temperature control was maintained by external coils enveloping the chamber and carrying cooling oil. The heat taken up by the cooling oil is utilized in the process.

Recently it has been claimed that increased yields are possible by arranging the process in three stages and removing the more condensible fractions in each stage. The hydrocarbons produced by the process require only a light alkali wash to remove traces of fatty acids, and is of good quality in respect of colour, odour and sulphur content.

Yields of various products and distribution of olefine hydrocarbons in the products obtained from a synthesis using cobalt catalyst are :

Product.	Boiling Range " C."	Yield % by wt.	Olefines in Fraction (% vol.).
" Gasol " . . .	below 300	4	50
" Benzine " . . .	30 to 200	62	30
" Oil " . . .	above 200	23	10
Soft Wax . . .	M. pt. 50	7	—
Hard Wax . . .	M. pt. 70 or over	4	—

Various lubricating oils may be produced by polymerization of the olefines in the presence of 5% aluminium chloride. A fraction of the oil boiling between 125° and 250° C. may also be chlorinated to mono- or dichloro-kogasin. The chlorinated products may be converted to lubricants by application of Friedel–Crafts reaction or by condensation with aromatics in the presence of aluminium chloride. Properties of products obtained by the Fischer–Tropsch process as modified by Synthetic Oils, Ltd., are detailed.

Details are given of world methanol production and of plants operating on the Fischer–Tropsch process. Estimated costs of gasoline production by this process and by the hydrogenation process according to published literature are given, and the economics of the synthetic process discussed. R. A. E.

1135. New Organic Syntheses. G. Natta. *Chim. e Industria*, 1938, **20** (4), 185–198.—A comprehensive review of work carried out on the synthesis of water gas and the preparation from the latter of methyl alcohol and higher alcohols and hydrocarbons, by the Fischer–Tropsch synthesis.

The properties of methanol fuel blends are reviewed. The paper also discusses the production of *iso*-octane, hydrogenated petrol, formaldehyde and the synthesis of acetylene, and the use of this gas for preparing other materials. W. E. J. B.

1136. Recommendation for an *iso*-Octane Plant in Japan. F. Horie. *J. Fuel Soc. Japan*, May 1938 (188), 54–56.—There is at present no plant in Japan for the production of polymer gasoline or commercial *iso*-octane. Owing to the relatively low cracking temperatures prevailing in Japanese refineries, contents of propene and butene in the cracked gases are, in general, very small, and consequently the gases

are very poor as raw material for polymerization. Also, there are only very small quantities of gas available from individual refineries.

As the production of high-octane aviation gasoline is an urgent necessity, the author recommends collecting gases from the five leading refineries in the Tokyo–Yokohama district and treating them in a central polymerization plant. The total daily volume available is estimated to be 70,000 cub. m. The various sections contemplated in this plant are enumerated, and annual yields are estimated to be :

iso-Octane	3860 Kl.
Polymer gasoline (above 80 octane) . . .	7850 ,,
Pentanes	7200 ,,

A new method suitable to local conditions is recommended for the production of *iso*butylene and butylene. L. R.

1137. **Patents on Polymerization.** Process Management Co. E.P. 489,105, 19.7.38. Polymerization of normally gaseous hydrocarbons to produce gasoline.

Standard Oil Development Co. E.P. 489,219, 18.7.38. Production of motor spirit consisting of a petroleum naphtha and a substantial quantity of a hydrogenated polymer obtained by acid polymerization of *iso*- and normal butylenes in the liquid or gaseous phase.

M. T. Carpenter, R. F. Ruthruff and J. K. Roberts. U.S.P. 2,122,878, 5.7.38. Polymerization of saturated gaseous hydrocarbons which may have a high methane content to form gasoline. W. E. S. C.

Refining and Refinery Plant.

1138. **Solvent Extraction of Diesel Fuels.** C. G. Dryer, J. A. Chenicek, G. Egloff and J. C. Morrell. *Industr. Engng Chem.*, 1938, **30**, 850.—The solvent extraction of various cracked diesel fuels with sulphur dioxide and furfural produced raffinates of substantially improved ignition quality, without appreciably changing the other physical properties of the fuel. The amount of improvement which could be effected depended on the solvent, percentage extract removed, and the method of extraction, sulphur dioxide being more selective than furfural. The raffinates showed a greater response to the addition of acetone peroxide diesel dope than the original fuels, and were as sensitive to pour-point depressants. Acid treatment of cracked and straight-run fuels effected a negligible increase in Diesel Index. Hydrogenation greatly increased the ignition quality, without loss of fuel or change in valuable properties, but it was not found possible to hydrogenate cracked fuels of high sulphur content.
J. W. H.

1139. **Controlling Electrolytic Corrosion in Refineries. Part I.** R. N. Coffman. *Oil Gas J.*, 30.6.38, **37** (7), 56.—The principles of electrical control of corrosion so successfully applied to pipe-lines may also be applied in oil refineries—for example, to condenser boxes and water-tanks. In such cases the chemical action occurs where the water comes into contact with the surfaces of condenser boxes, pipes or tanks. Theories of the electrolytic cell are considered in order to indicate the basis of corrosion control by cathodic protection—viz., (1) chemical action tends to take place between acids or wet salts and a metal, leading to flow of electric current from metal to electrolyte. If current flows, then chemical action is accelerated, leading to consumption of metal. (2) Such tendency to chemical action may be prevented by forcing electric current to flow from the acid or wet salts and into the metal. (3) The application of an external E.M.F. of only sufficient value to prevent such current flow in the circuit as would result from the chemical action of acids or wet salts on the metal, prevents such abnormal chemical action as would exist with a self-generated current flow in a direction from metal to electrolyte ; but would not eliminate normal chemical action, as would occur in cells with the electrodes not connected externally. (4) In order to prevent this normal chemical action, the amount of current necessary to flow from electrolyte

and into metal depends directly on the chemical affinity existing between the electrolyte and the particular metal. (5) The amount of chemical action which may be expected between an electrolyte—from pure distilled water to a heavy acid—and a particular kind of metal is directly dependent on the electrical conductivity of the electrolyte. For practical purposes there seems to be a direct relationship between resistance of electrolyte and its chemical affinity for a certain metal as expressed in terms of E.M.F. of polarization. Provided that the external E.M.F. remains constant and is sufficient to force enough current through an electrolyte of a certain resistance to prevent chemical action between that electrolyte and the cathode surface, the value of the current flow will automatically increase or decrease inversely with the resistance of the electrolyte and its consequent change in normal chemical affinity for the cathode metal, so that correct protection of the cathode surface will always exist.

In applying the method to protection of condenser boxes and water-tanks, it is necessary not only to know the minimum current flow, but also to have some knowledge of the current distribution in the system, and to know whether some portion of the cathode surface is not properly protected. The following general facts have been established in the laboratory and in practice: (6) Ohm's law applies to the ratio between applied voltage, and consequent current flow, and the resistance of the electrolyte between anode and cathode. (7) If all portions of the cathode surface are approximately equidistant from the anode, the current flow per square inch of cathode surface is equal. (8) Moving one portion of the cathode surface nearer to the anode increases the current flow to this particular portion, decreases the flow to the remaining portion and increases the current flow from the anode. This shows that a large current flow from the anode does not necessarily indicate efficient and adequate protection of the whole cathode system. (9) A formula for calculating the resistance between installed anode and cathode surface to be protected, devised by the author, if $R = \frac{CO}{A}$, where R is the resistance in international ohms between anode and total surface to be protected, A the total number of square inches in the anode surface, C the cube root of average distance in inches between anode and cathode, and O the ohms resistance between two electrodes each having 1 sq. in. of surface in contact with the water, spaced 1 in. apart in a sample of the water to be used in the system, the water being at approximately the same temperature as in the system. It is advisable to use alternating current in testing for this resistance. The formula applies only when the distance between anode and every portion of cathode is kept as near as possible to average distance between anode and all portions of the surface to be protected. It is applicable to the design of anode systems for either constant or varying level of water.

R. A. E.

1140. Controlling Electrolytic Corrosion in Refineries. Part II. R. N. Coffman. *Oil Gas J.*, 7.7.38, **37** (8), 58.—It is suggested that tables should be made available to enable the minimum current flow per square inch of the particular metal used in construction to give protection against an electrolyte of a certain resistance, to be ascertained when the value of O is known. In the majority of cases it would be impossible to secure proper protection by the installation of one anode, and an intelligent selection of suitable locations for anodes will be necessary, bearing in mind (7) and (8). Illustrations of selections of suitable positions are given. It is also necessary to know the E.M.F. required to force the minimum necessary current flow from the anode to a particular square inch of cathode surface (usually in a portion farthest from the anode). This can be calculated when the value of R and the minimum current flow for adequate protection are known.

In order to check whether the correct E.M.F. is being applied in an installation by means of a millivolt meter, the difference between the E.M.F. indicated with the control unit turned off and that indicated with the control unit turned on must be ascertained to eliminate cell effects between the electrode used for the test and the cathode surface.

Recommendations regarding the choice of instruments to be used for testing installations are made, and the application of the test method, bearing in mind the distance between anode and the portion of the cathode under test, is discussed. The considerable reduction effected in current consumption by the use of more than one anode in most commercial installations is illustrated by hypothetical examples. To protect

ordinary tank steel from an electrolyte of 360 ohms resistance, the author considers that the necessary current flow per square inch is lower in value than 0·000167 amp.
R. A. E.

1041. California Refinery Operates on Natural Lubricating Oil Stock. T. P. Sanders. *Oil Gas J.*, 28.7.38, **37** (11), 88.—N.E. of Bakersfield, California, lies a producing area which has been the scene of continuous development for several years. The sands are shallow (1400–2000 ft.), drilling is rapid and the crude has proved to be ideal lubricating-oil stock. A refinery owned by Golden Bear Oil Co. at Bakersfield operates solely on Poso Creek and Coffee Canyon crude making no gasoline, but only lubricating oils, liquid paving asphalts and road oils. The crude ranges in A.P.I. gravity from 14° to 16°, in sulphur content between 0·24% and 0·60% and contains no wax. Special precautions are taken to avoid cracking of the oil. The crude is heated to 600° F. in a pipe-still and passes to the first-stage vacuum tower carrying 12-in. vacuum. Overhead cuts taken from this tower are kerosene distillate, gas oil and a neutral oil of viscosity S.U. of 100 secs. The bottoms are conducted to No. 2 pipe-still, heated to 650–675° F., and passed to the second-stage vacuum tower carrying 28½-in. vacuum. Three overhead fractions are taken from this tower: (1) neutral oil of viscosity S.U. 150–200 secs., (2) medium cut of viscosity S.U. 1000 secs.; (3) heavy oil of viscosity S.U. 5000 secs. The bottoms from the second tower consist of asphalt of 50-penetration at 77° F. The yields obtained are: kerosene distillate 5%, gas oil 11%, 100 viscosity neutral 6%, 150–200 viscosity neutral 6%, 1000 viscosity oil 20%, 5000 viscosity oil 10%, asphalt 42%. The neutral oil cuts blended with heavier oils yield motor oils without further treatment, since wax is absent and the sulphur contents are low.
R. A. E.

1142. Patents on Plant. H. D. Newell. U.S.P. 2,123,144, 5.7.38. Tube for use at high temperatures—*e.g.*, 1000° F.—in heating fluids under high pressure—consisting of an alloy of 8–10·5% Cr, 1·2–2% Mo, not > 0·15% Co and free of Al.

J. H. Vital. U.S.P. 2,123,490, 12.7.38. Improved still for refining oils.
W. S. E. C.

Chemistry and Physics of Petroleum.

1143. Sulphuric Acid Analysis of Gaseous Olefins. M. P. Matuszak. *Industr. Engng Chem. Anal.*, 1938, **10** (7), 354–360.—The analysis depends on the selective absorption of olefins by sulphuric acid. Contact of gas sample with acid of increasing strength removes, in turn, *iso*butylene, propylene and ethylene. *n*-Butenes, which are absorbed with propylene, must be separated by a preliminary fractional distillation into cuts of approximately uniform molecular weight, and a similar course must be taken if any five carbon atom compounds are present.

Numerous tables are given showing the effect of various factors on the reliability of the method, and data on the following limitations of accuracy have been obtained:

1. Incomplete specificity of the absorbent. Small quantities of the next fraction are always absorbed together with the constituent being analysed, and the usual methods advised for calculating these absorptions are said to be inaccurate.
2. Reversibility of the absorption of the gas by the sulphuric acid.
3. Physical solution of paraffins in sulphuric acid—this is negligible only if the acid concentration is less than 90%.
4. Solution of hydrocarbons in the dissolved olefin-absorption products, and, to a larger extent, in precipitated polymers.
5. Production of unabsorbable gas by over strong absorbents.

The author maintains that the best way of improving the method is by the automatic reduction of these errors to a point at which they become negligible. This is brought about by the use, in each stage, of a preliminary absorbent, so weak that it requires no correction for incomplete specificity, to reduce the concentration of the olefin to a point at which the stronger final absorbent may be used reliably. Dobryanski's

figures for the rate of absorption of olefins by sulphuric acid of different concentrations are quoted, and the desirable concentrations for the specific absorption of the various olefins deduced from them.

The optimum strengths are :—

Olefin.	Preliminary Absorbent.	Final Absorbent.
*iso*Butylene	60–62% H_2SO_4	68–70% H_2SO_4
n-Butenes, propylene .	80–82% H_2SO_4	88–90% H_2SO_4
Ethylene	88–90% H_2SO_4 + 0·9–1·0% Ag_2SO_4	98–100% H_2SO_4 + 0·4–0·5% Ag_2SO_4

Apparatus is described for the convenient carrying out of the analysis under the best conditions, and it is stated that passes, each allowing 30 sec. contact between sample and 1 ml. absorbent, are most efficient when the absorbent is changed every alternate pass. This frequent renewal of absorbent is said to reduce the errors described under (2) and (4) above very considerably. In general, the solubility of paraffins in the absorbent is negligible except in the final absorption of ethylene. It is corrected for in the same way as allowance is made for the incomplete specificity in the absorption of the higher olefins, by the continuation of absorption until it becomes constant for each 1 ml. portion of final absorbent and multiplication of the constant absorption by the number of portions used.

With the apparatus and detailed technique described, the author claims an accuracy of within 0·2%. T. T. D.

1144. Catalytic Isomerization of Normal Octane. Y. K. Yur'ev and P. V. Pavlov. *Oil Gas J.*, 11.8.38, **37** (13), 55.—Experiments have been made on the isomerization of normal octane at 300–310° C. in a stream of hydrogen using as catalysts Pt on activated carbon, Ni on Al_2O_3 and Ni on ZnO. The effect of the catalyst carriers (activated carbon and Al_2O_3) on the isomerization was also studied. The products obtained from the isomerization were fractionated into three cuts : (1) fraction boiling up to 123·5° C., (2) fraction 123·5–124·5° C. and (3) fraction boiling above 124·5° C., and the refractive indices, specific gravities and weight of *iso*-compounds present in each fraction determined. Using the Pt catalyst, a 15% conversion to *iso*-compounds took place, whereas with Ni on Al_2O_3 only 5·5% conversion was obtained. Unsaturated and aromatic hydrocarbons were obtained with Ni on ZnO and with activated carbon, but not with the other catalysts. C. L. G.

1145. Isomorphism of Paraffins. Mathieu. *Revue Petrolifere*, 1.7.38 (792), 867.—In view of the difficulties caused by isomorphism in the analysis of complex organic mixtures, the study of the molecular structure is of greatest importance. It appears from recent investigations that there is a greater analogy between the liquid and the solid (especially crystalline) state than between the liquid and gaseous state.

The phenomenon of molecular association in crystals based on isomorphism bears close analogy to the phenomena of wetting ability and solubility. The view is supported that the two latter phenomena are caused either by polar properties of the molecules or by a close relationship of structure—isomorphism. Consequently, the isomorphism of paraffins in the solid state is the same phenomenon as their mutual solubility. L. R.

1146. Dehydrogenation of the Lower Paraffins over Activated Alumina Catalysts. J. Burgen, H. Groll and R. M. Roberts. *Oil Gas J.*, 8.9.38, **37** (17), 48.—In view of the increasing demands for the lower olefine hydrocarbons for the manufacture of synthetic chemical and gasoline products, an investigation has been made of a process for their production by the dehydrogenation of the corresponding paraffins. In the pyrolysis of hydrocarbons the breaking of carbon to carbon bonds predominates, but at lower temperatures, attained by the use of a suitable catalyst, olefin formation by dehydrogenation should predominate. The activity of the catalyst depends on its chemical composition and its physical structure, a high adsorptive capacity being essential. The presence of water vapour, or H_2S, or both, is also essential. The porous commercial variety of alumina, as used as a drying agent, is suitable as a catalyst. A method of preparing a similar product in the laboratory has been worked out.

Optimum temperature ranges and space velocities for the dehydrogenation of butane, *iso*butane and propane have been determined, higher temperature increasing the rate of reaction, and eventually that of side reactions and lower temperatures decreasing the rate of reaction, whilst low-space velocities give the highest conversion. However, high-space velocities increase the conversion per unit of time per volume of catalyst, although decreasing the activity of catalyst more rapidly. In tests with *iso*butane at 600° C. and a space velocity of 3·3 per minute a 31·6% conversion to *iso*butene was obtained, whereas at 650° C. and a 35 per minute space velocity the conversion was 17·5%. The optimum water content of the feed (0·1 mol-%) is obtained by passing the moist feed over $CaCl_2$. The alumina catalyst is very suitable as a carrier for other catalytic substances, and also may improve their stability—*e.g.*, chromium oxide is unstable at 500° C. by itself, but may be used successfully with alumina. It may also modify the activity of catalysts such as nickel oxide or iron oxide which normally favour disruption of the hydrocarbon molecule.

The preparation of the chrome-alumina catalyst may be modified so as to provide the optimum Cr concentration for the particular hydrocarbon. Thus *n*-butane requires a higher Cr concentration than propane or *iso*butane. It is shown that the activity of the catalyst is in line with the adsorptive capacity, both being reduced by the presence of alkali radicals (with sodium bichromate), but increased by the presence of chromium as chromic acid. The carbon deposits on the catalysts are best removed by heating with air at 600–700° C., the regeneration time being decreased by substituting N, CO_2 or steam for the air. Both the plain activated alumina and the chrome-alumina catalysts have been regenerated over 200 times without loss of activity.

C. L. G.

1147. Boiling Points of Benzene, Ethylene Chloride, *n*-Heptane and 2 : 2 : 4-Trimethylpentane over the Range 660–860 mm. Pressure. E. R. Smith and H. Matheson. *Bur. Stand. J. Res.* (*Wash.*), 1938, **20**, 641–650.—Determinations of the boiling points of these four organic liquids over a pressure range 660–860 mm. mercury have been made by the comparative ebulliometric method, using water as the reference standard and ebulliometers of the Swietoslawski type.

Two equations for each of these liquids have been obtained, one giving the boiling point as a function of pressure, and the other pressure as a function of temperature.

The deviations from actual measurements were in every case quite small.

The use of these substances as reference standards for boiling-point measurements is discussed.

Equations are also given for the relative volatilities of the two pairs, *n*-heptane–2 : 2 : 4-trimethylpentane and benzene–ethylene chloride.

The data obtained have also been used to test Dühring's rule, which gives an empirical relationship between the temperatures at which two liquids have equal vapour pressures. This relationship was found to hold accurately over a limited range of pressure, even for substances of different types.

D. L. S.

1148. Phosphorus Pentoxide as a Catalyst in Hydrocarbon Reactions. B. Malishev. *Oel u. Kohle*, 1938, **14**, 479–483.—This paper is a survey of the catalytic activities of P_2O_5.

The mechanism of this catalyst is discussed and is compared with that of aluminium chloride and contrasted with that of phosphoric acid.

Ipatieff's theory that all catalytic hydrocarbon reactions require the presence of water is examined, and in this connection it is stated that metaphosphoric acid formed by the presence of small quantities of water in P_2O_5 is inactive, whilst the *ortho*-acid reacts in an entirely different manner.

D. L. S.

1149. Methylene. T. G. Pearson, R. H. Purcell and G. S. Saigh. *J. Amer. chem. Soc.*, 1938, 409–424.—The authors have found that keten at the temperature attained by a quartz tube heated in a good blast Bunsen burner, is decomposed to liberate large quantities of free methyl which have been detected and identified, but that detectable concentrations of methylene were never obtained.

The exposure of keten, however, to light in the region 2580–3130 A. yields much

methylene, which was identified by the formation of the various polymers of telluro- and seleno-formaldehydes and their addition compounds with mercuric halides.

The photochemical and thermal dissociation of diazomethane streaming at a low pressure and high velocity through a silica tube gave free methylene in both cases, which was identified by conversion into telluro-formaldehyde.

The properties of methylene, more particularly its life period, have been studied. It appears to have three different half-value periods, depending on the environment and is to be regarded rather as a highly reactive molecule, than as a free radical in the sense that methyl is. It would appear that carbon in methylene is essentially bivalent.

W. E. J. B.

1150. New Absorbent for the Removal and Recovery of Carbon Disulphide from Industrial Liquids and Gases. C. D. Mitchell and D. W. Parkes. *Trans. Soc. chem. Ind.*, 1938, **57**, 113–116.—It has been found that the reaction between certain secondary amine salts of substituted dithiocarbamic acids, metallic hydroxides, and carbon disulphide is reversible between 15° and 100° C. in the presence of water. The reaction has therefore been studied with a view to its application to a cyclic process for the removal and recovery of carbon disulphide. Piperidine pentamethylenedithiocarbamate, magnesium hydroxide, and carbon disulphide react in the presence of water at room temperature, forming a solution of magnesium pentamethylenedithiocarbamate; this when boiled is decomposed quantitatively into its original components.

The reaction has been applied to the washing of a crude benzole, and data included in the paper indicate the cost of CS_2 removal to be 0·066*d.* per gallon per 0·1% of sulphur removed. This figure does not allow for the value of the recovered CS_2.

In a modified form the reaction has been applied to CS_2 removal from gases.

W. E. J. B.

1151. Properties of Spirits Produced by Hydrogenation-Cracking of Low Temperature Tar. J. H. Carlile, C. M. Cawley and C. C. Hall. *Trans. Soc. chem. Ind.*, 1938, **57**, 240–242.—Typical spirits produced in the single-stage process in the presence of a molybdenum sulphide catalyst supported on a lumina gel, produced in a semi-technical scale plant treating 200–400 gals. of tar per day, show a gravity of 0·79–0·81; % at 100° C., 19–27; % at 150° C., 70–87; F.B.P. 180–200° C., octane no. 67–69 C.F.R. M.M., and aromatic content 22–26% by weight.

By complete conversion the yield of this spirit amounts to 101% by volume. By re-treatment of this spirit it is possible to increase the percentage at 100° C. to 52, but the yield falls to 85%.

Experiments carried out in the laboratory scale plant at a temperature of 400° C. and a pressure of 200 atmospheres in the presence of pelleted molybdenum or tungsten disulphide, gave spirits of the following properties: sp. gr. 0·73% at 100° C. 52, aromatic content less than 2% by weight, octane no. 69–71, raised to 83½ by the addition of 4 ml. T.E.L. per gallon.

W. E. J. B.

1152. Interaction of Ketones, Carbon Monoxide, and Steam. D. V. N. Hardy. *J. chem. Soc.*, 1938, 464–468.—Organic acids have been obtained from acetone and methyl ethyl ketone by high-pressure treatment, 200 atmospheres, with carbon monoxide and steam in the presence of phosphoric acid at a temperature of 200–210° C.

Acetone gave rise to a mixture of acetic and trimethyl acetic acids in the approximate molecular ratio of 2 to 1. With methyl ethyl ketone, acids and unsaturated neutral oils were produced.

The acid mixture was complex, containing, amongst others, acetic, propionic, dimethylbutyric and dimethylvaleric acids. The ketones, acetone and methyl ethyl ketone condense to mesityl oxide and homomesityl oxide, respectively. These undergo hydrolytic fission into lower acids and olefins. In the presence of carbon monoxide the olefins pass mainly into higher acids, but in the absence of carbon monoxide they undergo polymerization.

An experiment with acetone and steam in the presence of phosphoric acid and an inert gas yielded a neutral unsaturated material, which on hydrogenation gave a

motor spirit fraction of 81 octane no. The latter was a little lower than expected, but the conditions of polymerization were severe. W. E. J. B.

1153. Synthesis of Disubstituted Acetylenes. J. R. Johnson, A. M. Schwartz and T. L. Jacobs. *J. Amer. chem. Soc.*, 1938, **60**, 1882–1884.—A study has been made of the alkylation of metallic derivatives of monosubstituted acetylenes. The action of alkyl *p*-toluenesulphonates on the sodium or bromomagnesium derivatives of alkyl- or aryl-acetylenes has been found to be a satisfactory procedure for the preparation of a variety of disubstituted acetylenes. W. E. J. B.

1154. Heat Capacity, Vapour Pressure, Heats of Fusion and Vaporisation of Propane. J. D. Kemp and C. J. Egan. *J. Amer. chem. Soc.*, 1938, **60**, 1521–1525.—The heat capacity of condensed propane has been measured from 15° K. to the boiling point. The melting point was found to be 85·45 ± 0·05° K., the boiling point 231·04 ± 0·05° K., the heat of fusion 842·2 ± 0·8 cal./mole and the heat of vaporization 4487 ± 4 cal./mole.

Vapour-pressure measurements have been made on liquid propane, and the results have been represented by the equation (liquid propane, 166–231° K. (0° C. = 273·10° K.)) $\log_{10} P(\text{Int. cm. Hg}) = -(1325{\cdot}358/T) + 9{\cdot}64920 - 0{\cdot}0118950T + 0{\cdot}0000134 2T^2$.

The density of propane gas at 298·10° K. and 1 atmosphere was found to be 1·8325 ± 0·0007 g./litre.

At 1 atmosphere at the boiling point the experimental entropy of propane (ideal gas) was evaluated as 60·45 ± 0·10 cal./deg. per mole. W. E. J. B.

1155. Approximate Molecular Weights of Higher Hydrocarbon Fractions. F. A. Lucy. *Industr. Engng Chem.*, 1938, **30** (8), 959.—Data by Mair and Willingham (*Industr. Engng Chem.*, 1936, **28**, 1457) and the author on the boiling points at 1 mm. pressure and the molecular weight of hydrocarbon oils are correlated by the equation $M = (T/35)^{2\cdot 276}$, where T is the boiling point at 1 mm. in ° K. P. D.

1156. Probable Structures of Polymers of Lower Olefines. A. Wachter. *Industr. Engng Chem.*, 1938, **30** (7), 822.—Several working rules are given for predicting the catalytic polymerization products obtainable from acyclic olefines, under conditions in which the rate of reaction is comparatively slow. These rules are based on the assumption of a particular mechanism, in which a hydrogen atom and an unsaturated alkyl radicle from one olefine saturate the double bond of another olefine molecule. Some consideration is given to the possibility of rearrangement of the original olefine before, and of the primary polymer after polymerization. Examples from the literature are quoted which indicate satisfactory agreement between predicted structures and those found experimentally; no adverse examples are given, however, to enable one to judge whether the balance of evidence is for or against the working rules put forward in this paper. H. E. T.

1157. Viscosity of Hydrocarbon Solutions: Viscosity of Liquid and Gaseous Propane. B. H. Sage and W. N. Lacy. *Industr. Engng Chem.*, 1938, **30** (7), 829.—The viscosity of gaseous and liquid propane was measured at 100° F., 130° F., 160° F., 190° F. and 200° F., and at pressures from atmospheric to 2000 lb. per sq. in. The experimental results are given in a table, and viscosity–temperature and kinematic viscosity–temperature diagrams are derived. P. D.

1158. Solubility of Refined Paraffin Waxes in Petroleum Fractions. A. Berne-Allen and L. T. Work. *Industr. Engng Chem.*, 1938, **30**, 806.—A comprehensive study is made of the solubility relations between paraffin waxes and petroleum distillates. It is shown that direct relations exist between the molecular weights of the solvents and solutes respectively. A quantitative relationship is shown to exist between the wax solubility (X) and the following variables—paraffin wax melting point (m), average boiling point of non-aromatic solvents (Y), and solution temperature (t). This relationship is expressed by the equation $X = (1120 - 2{\cdot}97Y)\ 1{\cdot}1357^{(t-m)}$, which is presented graphically. The effect of the nature of the hydrocarbon

solvent on the wax solubility is examined. It is shown that the solubility temperature coefficient for wax in benzene is greater than for toluene, xylene or non-aromatic petroleum solvents. It is this characteristic of benzene that makes it a valuable dewaxing solvent. Graphs are presented illustrating all the foregoing conclusions and the relationship between the molecular heat of fusion of waxes, melting point and molecular weight. J. W. H.

1159. Fatty Acids from Petroleum. Oxidation Process in Russia. Anon. *Chem. Tr. J.*, 1.7.38, **103**, 5.—In the *Russ. J. of Appl. Chem.*, 1937, **10** (12), G. Petrov, A. Danilovich and A. Rabinovitch describe investigations into the production of synthetic fatty acids by the oxidation of petroleum oils. The oil is first refined with 18–20% oleum, the acid sludge being separated and finding use as a fat splitting catalyst. The oil is neutralized with 4% NaOH solution and treated with atmospheric oxygen at 90–150° C. for 48 hrs. in the presence of Ca naphthenate as catalyst, dissolved in the oil. The oxidized oil is treated with Na_2CO_3 solution followed by NaOH solution for 2–3 hrs. and the soap emulsion diluted to 15%. The mineral oil is extracted with the benzine and the remainder allowed to stand for 12–18 hrs. at 75–80° C., when 60% of the unoxidized oil separates, leaving a soap concentration of 20%. The latter is either concentrated or treated with mineral acid for the production of the free fatty acid, the separated oil being returned to the process.

The oxidation yields 15–20% fatty acids, but owing to the difficulty of separation, 3–4% of saponifiable matter remains in the oil, causing condensation, etc. Modifications have been effected which reduce this figure to 2–2·5%. Further investigation has shown that for complete extraction it is necessary to use a 10% excess of alcoholic alkali of 35° Be pressure or a catalyst such as β-naphthol. Separation of oil and soap is good if the solution contains $\geq$ 40–42% acids. Extraction can be improved by adding to the solvent about 30% by weight of high-boiling alcohols. C. L. G.

1160. On the Action of Adsorbent Earth. E. Erdheim, A. Blankenberg, and N. Zaharia. *Matieres Grasses*, 15.6.38 (362), 156–157.—It has been observed that the adsorbent earth used in the purification of a petroleum distillate became coloured a light violet. Using (*a*) alcohol and (*b*) acetone for extracting 28 gm. and 24·6 gm. of dry earth respectively, 160 cub. cm. and 190 cub. cm. of a dark-brown solution were obtained. After filtration and distillation, 3·76 gm. and 2·24 gm. of an almost black oil were separated. The alcohol and acetone-extracted oils contained 1·30 and 3·65% mineral matter respectively, composed of SiO_2, Al_2O_3, Fe_2O_3, CaO and MgO in varying proportions. Hence it is concluded that the two solvents extracted different compounds from the clay, and it seems that in the course of the adsorbent action of the earth various coloured lacquers are formed. The earth used in the experiments was "Sondafin," having an acid content of 0·02% expressed as HCl. L. R.

1161. Condensation of Mixed Vapours. J. L. Wallace and A. W. Davison. *Industr. Engng Chem.*, 1938, **30** (8), 948.—Film transfer coefficients were obtained for the condensation of ethanol–water vapour mixtures and of benzene and toluene vapours on the outside of a water-cooled tube. The results obtained on the two latter can be correlated by the Nusselt equation. The values obtained for steam were higher than the Nusselt equation, probably due to dropwise condensation.

When condensing a single-component vapour the temperature drop across the film may be taken to be the difference between the vapour and tube temperatures. If h is calculated in this manner for a mixed vapour, an "apparent" value is obtained. The actual value is obtained by taking the temperature drop to be that between the boiling point of the condensate and the tube. There is little difference between the actual and apparent values for mixtures containing more than 50 mol.-% of ethanol. For lower percentages the actual value of h may be as much as twice the apparent value. The actual values were compared with the Nusselt equation, and when the condensate and exit and entrance compositions are all nearly equal, good agreement is obtained.

The heat-transfer coefficients on the water side give satisfactory agreement with the equation proposed by McAdams ("Heat Transmission," p. 169) when the value of the constant is taken as 0·0166 as opposed to the value 0·0225 proposed by McAdams. P. D.

1162. New Type of Semi-micro Fractionating Column. S. D. Lesesne and H. L. Lochte. *Industr. Engng Chem. Anal.*, 1938, **10** (8), 450.—To obtain high efficiency, large throughput per hour, and low tendency to slugging, the authors have developed a column embodying a metal band rotating at 1000 r.p.m. in place of the usual packing or indentation. The water condenser is 10 cm. long and the column proper is 37·5 cm. long and of 6 mm. internal diameter. With a reflux rate of 1 drop per second after equilibrium has been established (at least 1 hour of total reflux), an efficiency of 15–16 theoretical plates is obtained. With the same stillhead but without the rotating band the efficiency is only four plates.

The authors add that the still can be used for vacuum work provided that the slow air leak through the packing box is not injurious. It has, in fact, been used in the vacuum fractionation of esters of petroleum acids, but no efficiency tests have been run.

The column is designed for use with volumes of 1 to 10 ml. T. T. D.

1163. Fractionation in Multiple-Draw Petroleum Columns. W. L. Nelson and C. H. Roland. *Industr. Engng Chem.*, 1938, **30** (7), 730.—The reflux in a fractionating column may be divided into two parts: that which disappears when proceeding plate by plate down the section, and that which passes through the section unchanged in quantity. The former is referred to as heat-balance reflux, and the latter as excess reflux. An equal fraction of heat-balance reflux may, as an approximation, be considered to disappear on each plate. Using this concept in conjunction with the usual equilibrium and material-balance equations, the authors develop an equation giving the ratios of mol. fractions of any component at the top and bottom of a section, which is composed of a series of terms containing the quantities of distillate and reflux, a constant dependent on the ratio of heat-balance reflux to excess reflux and the equilibrium constants of the component in question of the various plates in the section. In order to obtain the latter, plate temperatures must be assumed, and it is claimed that this can be done with sufficient accuracy to give a reliable answer. An equation is given by means of which the molar ratio of the component may be transformed to volume-% ratios.

The equations are capable of being developed as a tabular calculation, and have their main usefulness in analysing column performance. They are illustrated by an example on crude column producing gasoline overhead and naphtha as a side-stream. It is concluded that the plate efficiency is about 80%. P. D.

1164. Flooding Velocities in Packed Columns. T. K. Sherwood, G. H. Shipley and F. A. L. Holloway. *Industr. Engng Chem.*, 1938, **30** (7), 765.—Experiments by the authors, and results taken from the literature are correlated by plotting

$$\left(\frac{U_0^2 S}{gF^3}\right)\left(\frac{\rho_g}{\rho_L}\right)\mu^{0.2} \text{ against } \left(\frac{L}{G}\right)\sqrt{\frac{\rho_g}{\rho_L}},$$

where:

U_0 = superficial gas velocity based on empty tower, ft./sec.
S = surface area of packing, sq. ft./cu. ft. of tower volume.
g = acceleration of gravity, ft./sec. sec.
F = fraction of free volume in packing, cu. ft./cu. ft. of tower volume.
ρ_g = density of gas, lb./cu. ft.
ρ_L = density of liquid, lb./cu. ft.
μ = viscosity of liquid, centipoises.
L = superficial mass velocity of liquid, lb./sec. sq. ft.
G = superficial mass velocity of gas, lb./sec. sq. ft.

Surface tension of the liquid was found to have negligible effect.

The liquids used were water, glycerine solution, butyric acid solution and methanol, and the gases air H_2 and CO_2. The packings were carbon Raschig rings and berl saddles. The column was 12·7 mm. in diameter.

The curves given bear out the excellence of the method of correlation, and show the increase in flooding velocity obtained when the column is large enough for there to be no wall effect, and the further increase obtained when stacked rings as opposed to dumped rings are used. P. D.

1165. Heat Transfer Coefficients in Staggered Tube Banks : Influence of Tube Shape. C. C. Winding. *Industr. Engng Chem.*, 1938, **30** (8), 942.—The heat-transfer coefficients to an air stream were measured for banks of tubes of three types of cross-section, circular, streamline and oval. The circular tubes were 1·5 in. in diameter and the long dimensions of the other sections 2·0 in. The tubes were steam heated, and the condensate could be collected from individual tubes.

The streamline shape gives a higher overall heat transfer rate for the first three rows of tubes in the bank than do the other cross-sections, but for the remaining tubes gives a lower figure than is obtained from the round tubes. The oval tubes were less efficient than the other two shapes in all parts of the bank.

The data obtained for round tubes are compared with those of other investigators. It is shown that equations of the type proposed by Rieher and Colburn do not agree with the shape of the curves obtained when heat-transfer coefficient is plotted against mass velocity. P. D.

Analysis and Testing.

1166. Determination of Organic Sulphur in Gas. C. W. Wilson and W. A. Kemper. *Industr. Engng Chem. Anal.*, 1938, **10** (8), 418–419.—In the A.S.T.M. lamp method of estimating sulphur in gasoline—modified by the first author to include the estimation of sulphur in gas—it is suggested that the figure obtained by treating all the acidity produced as due to sulphur may be misleading owing to the possibility of other acidic products being formed. It is suggested that the sulphur is better determined as sulphate by titrating the absorbing solution with standard barium chloride solution using THQ (tetrahydroxy-quinone) as indicator (cf. Abstract No. 918).

Since the carbonate ion interferes in this titration, the excess sodium carbonate must be neutralized to the methyl-orange end-point, and the red colour produced discharged with a few drops of carbonate solution. The presence of the methyl-orange does not mask the red barium chloride tetrahydroxy-quinone colour, and the e.p. is easier to detect than the methyl-orange e.p. in acidimetry. The authors claim that the method is rapid, and as accurate as any other method so far described. T. T. D.

1167. Moisture Determination. W. Griffiths. *Industr. Engng Chem. Anal.*, 1938, **10** (7), 394.—A device to facilitate the reading of the meniscus level in the trap of the Dean–Stark moisture-content apparatus is described. It is said to be particularly useful in cases where high-water content of the material means that a 10-gm. sample must be used, and consequently where errors in reading the meniscus cause a magnified error in the ultimate result. T. T. D.

1168. Improved Trap for Moisture Determination by Distillation. E. E. Langeland and R. W. Pratt. *Industr. Engng Chem. Anal.*, 1938, **10** (7), 400–402.—The authors consider that in determining moisture contents by distillation with an immiscible liquid, advantage is often gained by using a liquid heavier than water. In the case, for example, of tetrachloroethylene, the high sp. gr. permits most of the materials to be dried to float, and thus prevents localized overheating and possible charring. The Dean–Stark trap cannot, of course, be used, and the authors have designed a trap, essentially similar to that used for the determination of diluent in crank-chamber oils (A.S.T.M. method D.322–35), to be used in its place.

When the distillation is complete, it is found that, normally, a drop of tetrachloroethylene remains suspended on the surface of the water. In order to obtain the correct reading, a little Tergitol 4 is added, which causes the drop to fall and makes the water–tetrachloroethylene meniscus as well as the air–water meniscus easier to read.

The results obtained by this method are found to be quite as reliable as those obtained by the Dean–Stark method. T. T. D.

Motor Fuels.

1169. Volatility of Gasoline–Alcohol Blends. I. Aoki and N. Isii. *J. Fuel Soc. Japan*, June 1938, 59–61.—It is shown by A.S.T.M. distillation that the volatility of blends

containing 10 and 20% alcohol is higher than that of pure gasoline. By equilibrium air distillation it has been found that gasoline containing up to 20% alcohol gave air–vapour mixtures of similar strength as obtained with pure gasoline, and it is concluded that, in spite of the great difference in A.S.T.M. distillation, engine operation will be little affected. L. R.

1170. Properties of Aviation Fuels. M. Akita. *J. Fuel Soc. Japan*, May 1938 (188), 52–54.—A list is given of the available gasolines on the Japanese market within the different octane ranges, with and without the addition of tetra-ethyl lead. Various means of obtaining high-octane aircraft fuels are discussed. It is concluded that *iso*paraffins or naphthenes with branched chains are the most suitable compounds for blending with gasoline to produce aviation fuels of superior quality. L. R.

1171. Patents on Motor Spirit. W. E. Kuhn. U.S.P. 2,120,134, 7.6.38. Treatment of cracked distillates in which lighter and heavier fractions are first separated, and the heavier fraction is refined to remove impurities. Normally gaseous hydrocarbons are separated from the lighter fraction, these are polymerized and a polymer naphtha is recovered and recirculated to the first separation operation.

B. Hopper. U.S.P. 2,122,795, 5.7.38. Stabilizing sulphur-containing petroleum oils which have been treated with copper chloride, against deterioration due to colour or gum. The oil is contacted with an aqueous solution of an alkali metal carbonate.

D. L. Yabroff and J. W. Givens. U.S.P. 2,123,492, 12.7.38. Separating mercaptans of more than 6 carbon atoms contained in a solution of an organic solvent for mercaptans. Mercaptans containing less than 5 carbon atoms are dissolved in the solution and the enriched solution is contacted with solid $Cd(OH)_2$ containing less than 30% of water. The reaction products are then separated from the solvent.

P. J. Wiezevich. U.S.P. 2,123,642, 12.7.38. Production of high anti-knock gasoline by introducing gasoline vapours into an enlarged zone and passing them countercurrent to an ester containing an aromatic nucleus having a selective solvent power for cyclic hydrocarbons and having a b. pt. above the boiling range of the gasoline. The solvent and extracted constituents of gasoline are removed from the bottom of the zone and the extracted constituents separated from the solvent by distillation.

B. B. Nutt. U.S.P. 2,124,148, 19.7.38. Removal of suspended solids from oil by passing it in suspension through voids in a bed of solid insoluble material coated with sodium plumbite solution.

H. V. Atwell. U.S.P. 2,125,235, 26.7.38. Production of motor spirit from cracked gases. W. S. E. C.

See also Abstract No. 1185.

Lubricants and Lubrication.

1172. Practical Running Tests with Gear Oils. K. O. Müller. *Oel u. Kohle*, 1938, **14**, 437–445.—This paper extends the work of Hagemann described in Abstract 457 (1938).

It investigates the relationship between the properties of oils and the efficient running of driving mechanisms. In particular, change speed-gears, reduction gears and rear-axle drives have been examined. The relationship between the origin of lubricating oils and power losses, low wear and material strain has also been considered.

The work was carried out on a test bench, and the driving mechanisms were run under idling conditions alternating with 75% load.

Tables are given showing the essential properties of the oils tested, the temperatures reached by the gears both under load and idling conditions and the ash contents of the oils after 24 hrs.' running.

Besides commercial lubricating oils, tests were run with narrow cut paraffin and naphthenic base oils, synthetic oils and blends of these with fatty oils. For comparison

tests were also run with a commercial E.P. oil, a high-viscosity paraffinous–fatty oil blend, an oil containing organic phosphorus compounds and a commercial hypoid gear oil.

The tables show that the paraffinous-type oils give the best results in these tests, and that the addition of fatty oils effects an improvement. The addition of graphite does not appear to confer any advantages on a gear oil, and it may act in the opposite direction.

As far as running temperatures were concerned, the oil containing phosphorus was no better than a straight mineral oil, and at high temperatures it tended to become very corrosive.

The same can be said of the E.P. oil and the hypoid gear lubricant, the latter showing very high wear under the conditions of these tests.

It is concluded that oils for gears should be of low viscosity, so as to obtain low idling temperatures, and thus prevent decomposition of oil under these conditions.

Also, if dopes are to be used, these should confer good film-forming properties, without being unduly corrosive. D. L. S.

1173. Impurities Contained in Used Engine Lubricating Oils. E. Schmitz. *Matieres Grasses*, 15.6.38, **30** (362), 157–158.—The various types of contaminants found in used engine oil are enumerated and examples given of the composition of drained oil of summer and winter use. The effects of different kinds of foreign matter and of the products of deterioration are discussed. The mean composition of used internal combustion engine oils, after dehydration, is as follows:

Gasoline	2%
Gas oil and light hydrocarbons	6%
Heavy products	3%
Lubricating oil	83%
Compounds precipitable by special solvent refining	4%

L. R.

1174. Why Drain Crank-Case, and When? G. A. Round. *J. Soc. Aut. Eng.*, 1938, **43**, 301–304.—The author discusses the changes which occur in motor oils owing to contamination with the following materials: water, soot, lead salts, fuel ends, dust, metals and oil decomposition products.

In the author's opinion, water in the crank-case represents the most dangerous type of contaminant. In very cold weather it may freeze, it can emulsify with the oil to form sludge which clogs the lubricating system, and combined with anti-freeze solutions can cause serious gumming of the rings and pistons.

A typical analysis is given of crank-case sludge, and the design of engine is considered in order to prevent water accumulation caused by condensation in cold weather, when the engine is in intermittent service.

The author does not believe that oil filters are of much effect in preventing water accumulation.

The discoloration of oil, due to the presence of lead salts, is discussed, and it is concluded that there is no evidence that the lead does any harm.

Regarding oil-decomposition products, the author considers that used-oil neutralization numbers alone are of little significance, and that the active acids from oxidation are harmful only to the cadmium alloy, copper, lead and hardened lead bearings. Tin base babbitt, steel, aluminium or other engine metals are not attacked, and it is believed that engine design can control corrosion troubles.

The need for design to lower engine temperatures, particularly at the piston, is stressed, and a danger that oil filters may remove special addition agents added to diesel engine lubricants to minimize ring sticking is mentioned.

The author concludes that the question of when crank-case oil should be changed a function of the conditions of use of the engine. W. E. J. B.

1175. Patents on Lubricating Oil and Wax. E. M. Dons, O. G. Mauro and D. B. Mapes. U.S.P. 2,122,457, 5.7.38. Solvent extraction of hydrocarbon oil using dichlorethyl-ether, cresylic acid, nitrobenzene, furfural, etc.

O. L. Roberts. U.S.P. 2,123,205, 12.7.38. Solvent extraction of hydrocarbon oils using nitrothiophene.

E. M. Dons and D. B. Mapes. U.S.P. 2,123,503, 12.7.38. Refining of blended lubricating oils by treating a viscous petroleum residue which has been diluted with pentane, with H_2SO_4 and mixing the acid-treated solution with a lubricating-oil distillate. The mixture is then treated with H_2SO_4 and the pentane removed from the treated blend of residue and distillate.

M. P. Youker. U.S.P. 2,123,821, 12.7.38. Fractional distillation of lubricating oils.

E. C. Knowles. U.S.P. 2,123,833, 12.7.38. Dewaxing of hydrocarbon oil using a wax crystal modifying substance and a mixture of dipropyl and methyl ethyl ketones.

E. R. Wiles. U.S.P. 2,123,982, 19.7.38. Preparation of high m. pt. waxes by dissolving an undistilled residue of a petrolatum distillation in excess of ethylene dichloride and cooling to room temperature to precipitate the wax fractions.

F. R. Moser. U.S.P. 2,124,531, 26.7.38. Dewaxing a hydrocarbon oil by adding a polymerized mineral oil extract which is soluble in SO_2.

J. A. Buchel and R. N. J. Saal. U.S.P. 2,124,606, 26.7.38. Solvent extraction of hydrocarbon oil using acetone-benzol, furfural, etc.

A. S. de Stagni. U.S.P. 2,124,814, 26.7.38. Purification of used lubricating oils by adding an aqueous solution of $Na_2O : 2SiO_2$ and $Na_2O : 3SiO_2$ of density 38–42° Bé, leaving the mixture to stand and separating the impurities from the oil.

W. S. E. C.

Asphalt and Bitumen.

1176. Patents on Asphalt. J. S. Wallis and H. R. Sevanson. U.S.P. 2,122,764, 5.7.38. Apparatus for the preparation of blown asphalt. W. S. E. C.

Detonation and Engines.

1177. Motion Pictures of Engine Flames Correlated with Pressure Cards. G. M. Rassweiler and L. Withrow. *J. Soc. aut. Engrs*, 1938, **42**, 185–204.—This article describes a continuation of the work with the high-speed camera described at the Society meeting of June 1936, and to a very large extent is concerned with a description of the methods developed to accurately measure pressures developed at the time the photographs are taken.

Only one set of conditions were employed throughout the series of tests described, viz. :—

Speed	900 r.p.m.
Spark advance	25°
Fuel	*iso*-Octane
Air Fuel Ratio	13–1
Comp. Ratio	4·6–1
Throttle	Fully open

and it is emphasized that the work is by no means completed. Other conditions are being investigated, and efforts are being made to improve the reliability of pressure measurements. It is found that when pressure changes resulting from combustion are put on a percentage basis, the percentage of pressure rise due to combustion is approximately equal to the per cent. of charge burned (by weight) at the corresponding instants in the combustion period. C. H. S.

1178. 1937 Road-Knock Tests. T. A. Boyd. *J. Soc. aut. Engrs*, 1938, **42**, 244–252.—The Co-operative Fuel Research Committee has sponsored many series of road tests since the first extensive tests at Uniontown in 1932. Similar work has been under-

taken concurrently in England by the Institute of Petroleum, and the present report gives details of the 1937 road tests carried out in the U.S.A. and the results obtained. A very wide range of fuels was included in this series: nineteen winter grades and seventeen summer grades being tested in sixty-four and fifty-six cars respectively. The results show beyond reasonable doubt that certain types of temperature sensitive fuels are rated too high or too low by the existing C.F.R. Motor Method. It is hoped that a continuance of research on this problem will eventually result in laboratory ratings of motor fuels sufficiently in agreement with car ratings as to be generally accepted. C. H. S.

1179. Diesel Supercharging: its Effect on Design and Performance. R. Pyles. *J. Soc. aut. Engrs*, 1938, **42**, 215–223.—The possible means by which greater output per unit volume displacement, lower specific weight, and lower specific engine volume may be attained are as follows: increased engine speed; increase in mean effective pressure; the utilization of the two-cycle principle; and supercharging.

After dealing very briefly with the first three methods, the author discusses at length the problems involved in supercharging. The effect of the location of the blower drive on amplitude and frequency of torsional vibration, and the effect of supercharging on bearings, crankshaft, piston, and fuel consumption are the main problems discussed. It is concluded that brake mean effective pressures may be increased up to 50% by supercharging without the introduction of factors requiring major design charges. The particular features demanding consideration are: the necessary reduction in compression ratio; the complete scavenging of the clearance volume; the location of the blower drive; provision for effect of increased gas pressure on con-rod bearing stresses; the effect of the increase in harmonic torque on stresses in critical speeds. C. H. S.

1180. Motor-Car Engines in England. A. Taub. *J. Soc. aut. Engrs*, 1938, **42**, 229–242.—In comparing the engineering practice between American and European motor-cars, the author agrees that many of the differences are inevitable in view of local conditions, but contends that the British car is very much inferior to the American in respect to cylinder wear and carburation. For this he contends that there is really no excuse, and the paper deals mainly with these two problems. The reluctance in Britain to adopt light oils is one of the major causes of high wear, and much data are given showing the effect of piston-ring design on the problem of oil control. The relation between mixture ratio and wear is also dealt with, and it is stated that even in the part throttle range the difference between 12–1 and 14–1 mixture ratio may halve the cylinder wear in favour of the weak mixture, presumably due to the weaker mixture being drier and having less effect on the oil film. An illustration of this is given from practical tests, although it is admitted that the other factors, such as variations of coolant temperature round the various cylinders, may also be a factor. The possible effect of spark timing as affecting time of maximum pressures is another factor discussed. The author does not think that expensive austenitic products are necessary in order to obtain satisfactory solution of the wear problem, and contends that 50,000 miles of good performance is possible with cast-iron rings and sleeveless bores.

The carburation problem is, from the point of view of economy, the ability to supply uniformly lean mixtures of part throttle, and to satisfactorily burn such mixtures. Relatively rich mixtures for starting and full throttle must also be available. In addition, combustion-chamber design, extent of exhaust dilution, spark-plug design and location and ignition voltage are important factors bearing on the problem, and these are discussed. Extensive data are given dealing with carburettor performance determined with "flowbox" apparatus and the methods adopted to achieve the required results. C. H. S.

1181. Compressed Gas Vehicle. H. E. MacGillivray. *Fuel Econ.*, 1938, **14**, 211–212.—Gas cylinders for use on road vehicles powered by I.C. engines using gas as fuel, manufactured from alloy steels containing nickel, chromium and molybdenum are 73 in. long, 8 in. O.D., wall thickness 0·22 in. Internal volume 1·76 cub. ft. with a working pressure of about 3000 lb. per sq. in. Each cylinder, therefore, carries about 350 cub. ft. of free gas.

With gas at 475 B.Th.U. per cubic foot each cylinder is equivalent to 1·33 galls. of petrol, and allowing seven cylinders as required on a commercial vehicle, the unladen weight is increased by about 7½ cwt.

At a gas cost of 4*d*. per therm, fuel costs using gas would correspond to a petrol cost of 5·05*d*. per gallon. This figure is increased to just under 10*d*. per gallon allowing for compression cost and for storage and depreciation of storage plant.

It is felt that the field of the gas vehicle is in competition with the lighter class of petrol vehicle, and not the diesel-engined vehicle.

Advantages claimed for the gas-propelled vehicle are: elimination of lubricating oil dilution, negligible carbon deposit and better starting. W. E. J. B.

See also Abstract No. 1174.

Coal and Shale.

1182. Hydrogenation of Coal and Coal-Tar Oils under Turbulent Flow Conditions. G. Morgan and J. T. Veryard. *J. Soc. chem. Ind.*, 1938, **57** (5), 152–162.—The account of experimental work investigating the possibility of hydrogenating coal and coal oils, without catalysts, in a pipe system operated under conditions of turbulent flow. It is shown that with low-temperature tar oils and with coal suspended in anthracene oil, conditions of turbulent flow under pressure do materially increase the rate of reaction with hydrogen. Thus, with an external temperature of 560° C. and hydrogen under 200 atmospheres flowing at a rate to give a turbulence equivalent to a Reynolds No. of 5500, crude low-temperature tar yielded 32% by weight of gas, 18% of oil boiling below 200°, 30% boiling 200–310° and 20% boiling above 310° C.

This system of hydrogenation was, however, not wholly suited to the treatment of solids, owing apparently to the excessive carbon formation in the coils.

It is concluded that the system would be well suited to a preliminary hydrogenation of fluids destined for hydrogenation in reaction chambers containing catalysts, as by this means the contact of crude oil and catalysts could be avoided.

A special technique for welding together sections of pipe is described which ensures alignment of the internal bore. T. C. G. T.

1183. Patents on Coal. A. Pott and H. Broche. U.S.P. **2,123,380**, 12.7.38. Production of extracts from coal by the action of solvents boiling above 100° C. under normal pressure—the extraction being carried out at 330–415° C. W. S. E. C.

Economics and Statistics.

1184. Petroleum and the Trade Balance of France. L. Pineau. *Monit. Pétr. roum.*, 1938, **39** (8), 595–597.—The article shows how France has benefited by the installation of refineries behind a tariff wall. The amount of crude oil imported rose from 23,000 tonnes in 1929 to 452,000 in 1930; 1,035,000 in 1932; 4,322,000 in 1934; and 6,000,000 tonnes in 1936. For the same years the imports of petroleum derivatives were 3,014,000 tonnes, 3,073,000 tonnes, 3,467,000 tonnes, 1,833,000 tonnes and 1,302,000 tonnes. A table gives the value and quantity of the various products derived from crude oil in 1936, showing an increase over the cost of the crude oil, of 419 million francs (41% of cost).

Figures for 1937 are calculated showing that the balance of trade would benefit by 720 million francs through the establishment of the refineries, and the customs duties on imported petrol, etc., would give another 362 million. Other facts in favour of maintaining the industry and the duties are noted—*e.g.*, the purchase of steel plates, etc., in France by the refiners and the employment of 9500 men.

The second part of the paper considers the possibility of replacing petrol by local products—*e.g.*, alcohol, gas and fuel from the hydrogenation of coal. Gas-generating or compressed-gas vehicles number only a few thousands, although free from tax. The amount of alcohol used in I.C. engines has fallen from 14% of the total fuel so used to 5%, due to poor crops of beet and grapes.

The author suggests that urgent work should be done on the production of alcohol from colonial crops, such as molasses, rice and other grain, sisal hemp and on the hydrogenation of lignites. W. E. J. B.

1185. Manufacture and Use of Substitute Motor Fuels is Proving Costly in Europe. G. Egloff. *Oil Gas J.*, 8.9.38, **27** (17), 56.—A discussion is presented of the increasing use of substitute motor fuels from indigenous sources in Europe.

Coal.—The hydrogenation of coal in England provides 1,300,000 brls. a year of gasoline, whilst synthetic processes utilizing carbon monoxide are capable of producing 17,000,000 brls. a year in Germany and 110,000 brls. in France. The cost per U.S. gallon is given as about 18 cents. The total production of benzol fuel from coal in Europe is 824,500 m. tonnes, at a cost to the consumer, owing to loss of taxes, etc., of 20 cents per gallon more than that of gasoline.

Gas.—Compressed coal-gas, methane, ethane, butane and propane are being used by 25,000 motor vehicles in Germany. It is estimated that in 1938 over 150,000 tonnes of gasoline will be replaced The cost of conversion of vehicles to take compressed gas fuel is given as \$150 to \$300. Tax reduction brings the cost of city gas, methane and propane–butane to 43, 41 and 61 cents per equivalent gallon of gasoline, as compared with 59·6 cents for imported gasoline. In Italy natural gas in the Milan and Florence area is replacing 40,000 tonnes of gasoline a year, this quantity being expected to be quadrupled in two years.

It is estimated that in 1938 compressed gas will substitute 250,000 tonnes of gasoline in Europe.

Alcohol.—The use of power alcohol increased in Europe from 59,000 tonnes in 1930 to 648,000 tonnes in 1936, but declined to 510,000 tonnes in 1937, whilst 1938 shows a still bigger decline. This is attributed to the excessive economic loss (\$104,000,000 in 1937) and to its diversion for other purposes (*e.g.*, munition manufacture). Variation in the quality of alcohol supplies has also led to difficulties owing to continuous re-adjustment of engines. It appears that the primary reason for the compulsory use of motor fuel in Europe is to maintain the alcohol industries for the purpose of national defence.

Producer Gas.—The use of wood for generating producer-gas fuel is encouraged in France, Germany and Italy. It is estimated that 9000 vehicles are equipped for this purpose in Europe, using 450,000,000 lb. of wood to substitute 53,000 tonnes of gasoline. Owing to inconvenience, delay in starting, necessity for cleaning and reduced efficiency, the extended use of wood for this purpose is not likely. The use of producer gas from brown coal, lignite, anthracite coal, peat, coke, alone or mixed with wood or wood charcoal has also been tried.

Shale.—In 1938 shale motor fuel was produced in Europe to the extent of 38,800 tonnes, of which 26,000 tonnes were produced in Scotland. The cost of production is estimated at 15c. per U.S. gallon, loss of taxes, etc., amounting to another 15c. per gallon.

Other Fuels.—Liquefied ammonia, vaporized and cracked into H_2 and N_2, is used in Italy, but the heating value is low and the cost high. Acetylene cannot perform the full work of a gasoline engine, and the efficiency is highest with dilute air–gas mixtures. The use of hydrogen is also being tried, but does not look promising.

In 1937 the extra cost to the consumer and State above the cost of imported gasoline and losses in taxes amounted to about \$235,000,000, and is estimated to reach \$300,000,000 in 1938. C. L. G.

1186. Home-Produced Substitutes for Petrol in Germany. L. Jonasz. *Monit. Pétr. roum.*, 1938, **39** (10), 789–794.—With relatively small oil supplies in the country (453,000 tonnes of crude were raised in 1937), Germany is trying hard to find substitutes for the 1½ million tonnes (approx.) of petrol used every year.

There are in Germany about 3 million automobiles : 60% petrol, 35% diesel, 2½–3% gas, and the remainder, electric.

Synthetic Petrol.—184 million tonnes of lignite were mined in 1937 (equal to the weight of coal), and both lignite and coal are being submitted to hydrogenation by the Bergius and other methods. Petrol is also made from coke by the Fischer–Tropsch–Ruhrchemie method.

Gas.—Both gas-generator and compressed-gas vehicles are in use. At the end of 1937 some 6900 vehicles were running on Ruhr-Gasol. This is composed of propylene, butylene, propane and butane, by-products of the manufacture of synthetic petrol, stored under pressure in steel bottles, and sold at garages.

In some towns the buses use town's gas supplied at pressures of 200 atmospheres and over. With the invention of extremely strong alloy steels, which enables

bottles to be made weighing less than 1 kgm. per kgm. of compressed gas, town's gas is likely to become a more serious rival to the easily-liquefiable gases of the propane type.

Engine compression ratios in use are 1–5·5 for Ruhr-Gasol, 1–8 for town's gas, and 1–8·5 or 9 for gas-generating plant (Gasogene). Decompressors have to be fitted to reduce the pressure to 80 or 90 mm. of water, and re-heaters to counteract the accompanying decrease in temperature. A diagram of one is given.

The gas-generator (Gasogene) system is applied only to heavy vehicles. The power obtained from a given engine is some 30% less with this fuel. The generator consists of two parts: a chrome-steel furnace, burning wood charcoal, and the hopper, filled with charcoal, wood or semi-coke. The furnace is lit and brought to a red heat by forced draught, when the heat begins to distil the materials in the hopper. The gases given off are passed through the red-hot charcoal, which dissociates the tars and acids, and the net product is a mixture of carbon monoxide, hydrogen and carbon dioxide with various impurities. It is washed and purified, mixed with air, dried and fed to the cylinders.

German makers have concentrated mainly on gasogenes using heavy fuels such as anthracite and semi-coke, but the Department of Forests is boosting wood-consuming plant. There is a subsidy of 600 reichmarks towards the cost of each vehicle, and a 50% reduction in tax. A recent decree orders 75% of public service vehicles to use either gas or electricity.

The article is illustrated with photographs which show actual vehicles fitted with the various equipments described. W. E. J. B.

1187. Case for the Encouragement of the Producer Gas Vehicle in Britain. Coal Utilisation Council. *Fuel Econ.*, 1938, **14** (154), 245–246.—The article reprimands Britain's apathy towards the producer-gas vehicle, and points out that other nations with a desire to conserve oil show practical interest in this type of vehicle. It is claimed that it has been established that 16 lb. of coal can replace 1 gal. of petrol, and that the cost per mile, with a 31-seater bus under producer gas, is 0·7*d*. compared with 1·9*d*. for petrol and 1·0*d*. for diesel, that there is no crankcase dilution and less cylinder wear.

Following a survey of the economic effects of a large increase in producer-gas vehicles, the article demands that the producer should not be included in the unladen weight of such vehicles. T. C. G. T.

1188. Fuels Alternative to Oil for Road Transport Vehicles. B. Goldman. *Fuel Econ.*, 1938, **14** (154), 248–252.—The author stresses the claims of producer-gas vehicles and attempts to show that low-temperature carbonization in conjunction with producer gas is the most economic method of producing from coal, a fuel for internal-combustion engines.

Economic considerations and measures to encourage the adoption of producer-gas vehicles are surveyed. T. C. G. T.

1189. Home Fuels for Road Vehicles. H. E. MacGillivray. *Fuel Econ.*, 1938, **14** (154), 253–255.—The use of electricity, steam and compressed gas is outlined, but particular attention is paid to producer gas. It is claimed that the present tax legislation operates against producer gas in two ways.

1. A vehicle of an unladen weight under 2½ tons may travel at 30 m.p.h., but if over this weight at only 20 m.p.h. Present-day 2½-ton petrol or diesel vehicles have a pay-load of 5–6 tons. In order to have a similar pay-load, a producer-gas vehicle will have an unladen weight of about 3 tons, and hence the petrol or diesel vehicle can cover 50% more mileage.

2. The gross laden weights regulations are 12 tons for four-wheelers, 19 tons for six-wheelers, and 22 tons for eight-wheelers. Since the producer-gas vehicle has to carry a greater weight of fuel as well as the producer, it is 15–20 tons heavier than the petrol or diesel vehicle.

The author claims that this handicap ought to be adjusted by deduction of the weight of the fuel and producer. T. C. G. T.

1190. National Significance of Producer Gas Vehicle Utilization. Anon. *Fuel Econ.*, 1938, **14** (154), 247.—The encouragement offered on the Continent to producer-gas vehicles is illustrated by the statements that Germany gives £50 subsidy as well as tax relief for every installation, that Italy is attempting to eliminate diesel and petrol lorries to the benefit of producer gas, and that in France, where the vehicle has been encouraged, there are now 6000 on the road.

The British Government is pressed to allow about 10 cwt. off the unladen weight in order to permit such vehicles to overcome their present tare and speed handicap.

T. C. G. T.

1191. Development of the Fuel Resources of Canada. B. Goulston. *J. Soc. chem. Ind.*, 1938, **57** (25), 583–588.—Much research has been carried out in order to utilize the large natural fuel deposits of Canada; usually, however, economic considerations retard development. Coal is of poor quality and, geographically, unfavourably placed.

The peat, oil-shale and bituminous sands also have distinct economic disadvantages. The quality and quantity of the foregoing fuels, together with those of crude oil, are discussed.

Crude oil production in 1937, at nearly 3,000,000 brls., was double that of 1936, but is still only a fraction of Canada's consumption. 93% of production in 1937 was from the Turner Valley field. Natural-gas production in 1937 was 29½ million M.cub.ft., of which the greater part is burned to waste. Utilization of the natural gas is receiving attention.

The article contains a list of 71 references. T. C. G. T.

PUBLICATIONS RECEIVED.

Report on the Administration of the Northern Territory for the Year Ended 30th June, 1937. Pp. 77. Published by L. F. Johnston, Commonwealth Government Printer, Canberra. Price 3*s*. 3*d*.

Subsurface Geology and Oil and Gas Resources of Osage County, Oklahoma. Part 1. Townships 22 and 23 North, Ranges 10 and 11 East. By N. W. Bass, L. E. Kennedy, W. R. Dillard, O. Leatherock and J. H. Hengst. Pp. 45. U.S. Geological Survey Bulletin No. 900–A. Superintendent of Documents, Washington, D.C. Price 30 cents.

The four townships, the subsurface geology and oil and gas resources of which are described in this report, lie in south-eastern Osage County, Okla., 12 to 25 miles north-west of Tulsa. They are in the midst of a region that has many oil- and gas-fields, and these four townships contain more than 1800 wells. Oil or gas is produced from eleven beds, all of which lie at depths of less than 2600 feet in most parts of the four townships. Nine of the oil- and gas-bearing beds are in the Pennsylvanian series, one is in the Mississippian series, and one is in the Ordovician system.

The investigation has shown that in Townships 22 and 23 North, Ranges 10 and 11 East, there are several localities outside the oil-fields where prospecting may reveal new oil and gas deposits. Deep drilling in some of the producing fields should result in discovering additional oil and gas in beds that lie below the present producing beds.

Survey of Crude Oil in Storage, 1936–1937. By Petroleum Economics Division and Petroleum and Natural Gas Division, U.S. Bureau of Mines, Report of Investigations, No. 3417.

The primary objective of the survey was to make a physical inventory of the crude oil held in storage above ground, and to determine the quantities and characteristics of the light fractions contained in the various stocks.

The results of sampling and analysis indicated that the average quality of stored oil closely approximated that of the average current production. The reason given is that a large part of the older crude oil in storage was flush production from fields that produced high-grade oil. The original superior quality of these oils had offset the deterioration from evaporation losses, and progressive improvement in storage-tank construction had materially reduced the rate of such losses in recent years.

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Geology.

1192. Stratigraphy of Coastal Plain of Georgia. C. W. Cooke and A. C. Munyan. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 789–793.—A revision of the stratigraphy of the Coastal Plain of Georgia has recently been completed by the senior author. This work will, it is expected, be published later by the Department of Natural Resources of Georgia.

In the present paper a generalized map is given which shows the presence of formations ranging in age from Upper Cretaceous (Tuscaloosa) to Pleistocene (Terrace deposits). A much more complete outcrop of the formations occurs in the W. than elsewhere. Eleven series of deposits are exposed near Chattahoochee River, whilst near Ocmulgee and along the Savannah there are only four and three, respectively. This difference is due to progressive overlap, possibly as a result of down-warping in the eastern part of the State. It has been previously shown by other writers that post-Oligocene down-warp has taken place in the S.E. G. S. S.

1193. Recent Petroleum Activities in Coastal Plain of South Georgia. A. C. Munyan. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 794–798.—This is a brief account of the geology and topography of the Coastal Plain, together with some recent operations still in progress.

A structural map of the region was prepared by two other workers in 1923. This map, however, was founded on the presence of a greenish clay at the base of the formation, then termed the Alum Bluff, and now recognized as the Hawthorn which blankets the S.-E. part of the Plain. As shown by later work, the Hawthorn overlaps on to successively older rocks, and does not reflect the true position of these older formations.

A number of wells drilled in the past are of little or no value for correlation purposes, owing to lack of suitable records. Other than lithology, there appears to be little aid available for correlations, and it is now suggested that a distinct advance in this connection could be made if a detailed study of the micro-fauna was made.

G. S. S.

1194. Oil and Gas Possibilities in Atlantic Coastal Plain from New Jersey to Florida. O. C. Postley. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 799–815.—This paper gives

a short summary of known geological conditions and of deep wells drilled in the Atlantic Coastal Plain from New Jersey to Florida.

The sediments of the Plain range from Lower Cretaceous to Recent. Structurally, so far as known, no local anticlines or domes occur such as are present in the deposits in the Gulf Coast. Such a lack of deformation may be responsible in part for the barrenness of the Atlantic Coast in comparison with the productive fields on the Gulf Coast of Louisiana and Texas.

In general, the sediments of the Coastal Plain are characterized by an absence of thick beds of dark or carbonaceous material. The Cretaceous consists of both marine and non-marine deposits, ranging in thickness from a few hundred feet in New Jersey to possibly more than 3000 ft. in S.E. Georgia. The Tertiary consists mainly of sands, clays and marls with diatomaceous earths.

Although traces of oil and gas have been reported in Cretaceous sediments at a few places along the Atlantic Coastal Plain, the known aggregate thickness of these beds seems to be quite inadequate for the formation and accumulation of economic amounts of oil.

Wells have penetrated entire series of sediments and reached basement rocks, and separate attention is given to those wells that have passed through formations at depths of over 1000 ft.

A geological sketch-map is provided which also shows the location of wells as dealt with in the paper. G. S. S.

1195. Scanlan, or Midway, Dome, Lamar County, Mississippi. D. J. Munroe. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 816–822.—The Scanlan, or Midway, Dome is situated 14 miles nearly due W. of Hattiesburg, Lamar County, and 110 miles N.E. of the Sorrento Dome (Louisiana), the nearest producing salt dome.

Stratigraphically, the Eocene differs but little from that normal for the area, excepting for the rarity of sand bodies of any importance. Structurally, the dome is of a piercement type, and belongs (in the author's opinion) to the inland rather than to the coastal classification.

Late Tuscaloosa or pre-Eutaw time saw the salt movement at its maximum development, although it continued until late into the Oligocene. The resulting oil accumulation in the asphaltic sand occurred prior to the close of Tuscaloosa time.

The two most important facts arising from the Midway dome are: (1) the definite establishment of a salt-dome basin in Central Mississippi, and (2) the proof of the former presence of source-beds of sufficient extent to yield oil in large amounts, which is confirmed by the discovery of 152 ft. of asphaltic sand.

Future drilling only will reveal whether the Midway Dome will eventually become commercially productive. G. S. S.

1196. Application of Principle of Differential Settling to Tracing of Lenticular Sand Bodies. J. L. Rich. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 823–833.—An anticlinal bulge should develop by reason of differential compaction over thick but narrow sand bodies which are later covered with mud. This has been found to be the case when tracing the shoestring sands in Kansas, and a number of examples illustrating the application of the principle, are given. The recognition of these features depends on the presence of numerous outcrops of evenly bedded rocks, few or no lenticular sands above the sand body in question, and very detailed surface mapping. Difficulties which may arise are due mainly to the presence of structures developed by other causes and the offsetting of the surface feature to one side of the buried sand. Sands with a thickness of 75–100 ft. have associated surface features even when their depth of burial exceeds 2000 ft. S. E. C.

1197. Stratigraphy of the Bendian of the Oklahoma Salient of the Ouachita Mountains. B. H. Harlton. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 852–914.—The name "Bendian," given to the Carboniferous rocks of the Ouachita, was proposed in 1934. Since then, however, a great deal of stratigraphical research has yielded sufficient information to enable correlations and classification to be made. An endeavour is therefore made in this paper to work out the sequence, age and history of the Bendian.

It is proposed to split up the formation into two series: the Pushmataha (lower) and the Morrow (upper).

The Pushmataha.—This series consists mainly of massive sandstones and siliceous shales with conglomerates; it is subdivided into two groups Stanley below and Jackfork above. Further classification is made by subdividing the Stanley into the following three units (in ascending order): Ten-Mile Creek, Moyers, Chickasaw Creek; and the Jackfork into four subdivisions: Wildhorse Mountain, Prairie Mountain, Markham Mill, and Wesley.

The Morrow.—This is composed mainly of sandstones and shales in the lower horizons, and limestones in the upper horizons (particularly in the Wapanucka). The Morrow is also subdivided into groups—viz., Union Valley Sandstone, Primrose, Limestone Gap Shale, Wapanucka, and Barnett Hill.

Detailed descriptions (including thicknesses, lithology and fauna) are given of all the beds comprising the Bendian. The type localities have been very carefully selected in order to show the best sequence of these deposits. A wealth of text-figures and half-tones also accompanies the paper. G. S. S.

1198. South Arkansas Stratigraphy with Emphasis on the Older Coastal Plain Beds. W. B. Weeks. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 953–983.—The region described represents about one-fourth of the total area of Arkansas, and, except for the extreme north-western part, the region lies in the Gulf Coastal Plain. Much knowledge of its subsurface stratigraphy has been acquired since 1934. Deep wells ranging in depth from 3000 to over 8000 ft. have proved about 4000 ft. of sediments underlying the Travis Peak (Trinity) formation. A generalized description of all the strata in the area is given.

The Eocene is represented by over 1800 ft. of sediments. The formational units present in other areas are not easily recognized here, and discussion is largely confined to group names—Midway, Wilcox, Claiborne and Jackson. The sediments lie unconformably on the Gulf Series.

Divided lithologically into three groups, the Gulf Series consist of: a lower group of approximately 800 ft., made up largely of glauconitic shale, a middle consisting of 150–500 ft. of chalk, marl and shale, and an upper group of 600 ft. of sands and marls.

The Comanche Series (Fredericksburg, Paluxy, Glen Rose, Travis Peak) follow, and are approximately 4800 ft. at their greatest thickness in the S.W. of the area. The series thins in a short distance northwards, and is pinched out entirely by pre-Gulf truncation within 85 miles to the N.E.

Underlying these series, and also truncated, are (in descending order) the Cotton Valley formation, Bruckner and Smackover Limestone; these are generally believed to be Mesozoic in age.

Deposits of the Palaeozoic system drilled below the Mesozoic are represented so far only by the Eagle Mills formation (? Permian), Pennsylvanian, and possibly the Mississippian series; very little information is available regarding the correlation of these beds.

It may be inferred that there was continued overlapping from Eagle Mills time up through Comanche deposition. During post-Comanche times extensive uplift on the N.E. must have taken place, causing a south-westward tilting of these strata. A S.W.–N.E. cross-section is given illustrating the thinning and ultimate truncation of the sediments. G. S. S.

1199. Important Damman Dome Discovery in Deeper Horizon. Anon. *Petrol. Times*, 15.10.38, **40**, 508.—The early drilling of Damman No. 2 to the upper horizon gave an encouraging flow of oil at a depth of 2152 ft. Similar results were obtained with other wells, although they were not considered to prove a commercial field. Damman No. 2 was taken to a depth of 4715 ft., striking a deeper horizon for which production tests indicated a flow of 1500–2000 brl./day of 35-gravity oil. This well lies 1¼ ml. south and a little west of No. 7, the discovery well of the deep zone, which on test showed a capacity of 3700 brl./day of 34-gravity oil. G. D. H.

1200. Anglo-American's British Oil Search. Anon. *Petrol. Times*, 8.10.38, **40**, 469–470.—Midlothian No. 2 is to be drilled 780 yd. N.N.W. of No. 1, to make a partial test

of the flank of the main structure, which runs N.E.–S.W., and to obtain data regarding the saddle between the two domes on the structure.

In No. 1 open-hole tests of three sands between 2050 ft. and 2200 ft. depth gave 4,000,000 cu. ft. of gas at a shut-in pressure of 720 lb./in². Further tests have been made on the oil sand at 1733–1760 ft., which provided a little oil in June and July, and swabbing 2 hrs. daily for a fortnight gave 20–25 brl. of fluid/day, about half of which was oil. The well is not yet clean, and has been shut down pending the arrival of pumping equipment. G. D. H.

1201. Gulf Oil Corporation and Danish Oil Search. Anon. *Petrol. Times*, 1.10.38, **40**, 431.—Preparations are bing made to test a concession in Denmark. Test-drilling has been carried out over several years, giving promising results at Harte, near Kolding, in South Jutland, and near Fredericksbavn in North Jutland. Promising gas strikes have been revealed, as well as traces of oil, and geophysical work has shown structures which are deemed worthy of detailed examination. G. D. H.

1202. Hungarian Oilfield Progress. Anon. *Petrol. Times*, 1.10.38, **40**, 432.—Drilling in the sixth and seventh wells at Lispe has reached a depth of 1100 m., and oil-bearing strata have been entered. The total daily production of Lispe and Government wells is 180 tons, but it is hoped to reach 300 tons by the end of this year, and 600 tons/day by the end of 1939. G. D. H.

1203. Ground Gas Survey is Promising Tool. S. J. Pirson. *Oil Wkly*, 10.10.38, **91** (5), 34–44.—Not only does gas escape to the surface by paths of least resistance such as faults, but it is also able to travel through apparently consolidated and homogeneous rocks in a continuous manner, and, above oil- and/or gas-fields an effusion of hydrocarbon gases into the atmosphere takes place continually. The gas may travel through thousands of feet of overburden by (1) permeation, (2) effusion, or (3) diffusion.

Shales and water horizons have a very small permeability, and since shale beds and water horizons are always present above oil reservoirs, it seems unlikely that permeation is a very important factor in this escape of gases. However, permeation may take place through faults and joints. Hence there may be a high hydrocarbon gas distribution corresponding to a fault. There will be some fractionation in permeation, and by Darcy's law it is possible to calculate the approximate soil-gas concentration under given conditions. Effusion also will lead to some fractionation, for the lighter hydrocarbons will escape most readily. Formulae have been developed for the rate of effusion, and they may be valid for openings of $5–100 \times 10^{-8}$ cm. diameter.

Diffusion of gas through a solid is essentially chemical in nature, for the gas molecules actually penetrate the molecular structure of the material in order to emerge on the other side of a separating solid partition. This phenomenon is perhaps a most important factor in explaining the presence of hydrocarbons in the soil, for it gives the necessary explanation for the travel of gas through impervious strata such as massive limestones, shale beds, water-bearing horizons, etc. Fick's law, which governs this diffusion, is of the same type as Darcy's law, and gives similar pictures for the hydrocarbon concentration in the soil.

Samples of air from the ground or of soil are taken from holes a few inches to 30 ft. deep in a series of profiles across the area under test, and the gases are recovered in the laboratory. It appears that the heavy hydrocarbons alone are sought, although in Russia two fractions are collected to give the heavy hydrocarbon number $(HC)^H$ and the light hydrocarbon number $(HC)^L$. This permits oil- and gas-fields at shallow depths to be distinguished. For deeper fields some distinction is still possible, for a gas-field will not show any appreciable heavy hydrocarbon number. Hydrocarbon concentrations in the soil air of 1 in 1,000,000 seem to be significant, and for the best results from a survey, it is necessary to measure to 1 in 10,000,000. Formulae have been derived by Antonov and Sokolov for computing the depth of the gas source, and the former proposes to calculate the field pressure also. G. D. H.

1204. C.G.S. Unit for Permeability Measurements. W. Tiraspolsky. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 973–974.—The definition of a Darcy is unfortunate, in that the unit of pressure is an atmosphere instead of a fundamental quantity, as

are the rest of the units involved. It is therefore proposed that a new unit of permeability be adopted in which viscosity is measured in poises, instead of in centipoises as formerly, and pressure is measured in megabars, instead of atmospheres. It is proposed that the new unit be called a Metric Darcy. S. E. C.

1205. Application of Physico-Chemical Principles to the Investigation of the Properties of Rocks. *J. Instn Petrol. Tech.*, 1938, **24**, 351–392.

Part I. A. H. Nissan.

A study of the porosity of rocks and its significance in estimating reservoir capacity.

Part II. A. H. Nissan, C. E. Wood, L. V. W. Clark and A. W. Nash.

This section deals with the detailed technique of accurate porosity determinations. Two methods for determining the bulk volume of rocks to an accuracy of 0·2% are put forward. D. L. S.

1206. Analytical Study of Geological Sections. G. Delga. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 411–426.—Quite a variety of structural forms at depth can correspond with a given geological map, and generally the discovery of an additional piece of evidence calls for some modification of the original picture. The substitution of the tangent plane (dip) for the stratum is correct only for a very small element of space, and it is assumed that equations which are correct for the element of space can be integrated for the whole surface. The integration is considered for a plane cross-section only, with a view to determining thicknesses and predicting well logs.

Certain formulae are derived by the methods of analytical geometry, and a practical method of applying them is given. In certain cases the errors may be estimated. By interpolation it is possible to determine the structural geological characteristics of a given point. G. D. H.

1207. Oil Prospecting in Great Britain. Anglo-Iranian Oil Co., Ltd. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 31–34.—The history of the search for oil in Great Britain is outlined. Possible oil horizons are found in the Carboniferous, Permian, Jurassic and Wealden, and the possibilities of each are summarized. It is concluded that large and relatively shallow oilfields cannot be expected, and also that there is little reason to expect great reserves at depths of 10,000 ft. or more, but that, on the other hand, active exploration is justifiable if the limitations are borne in mind. S. E. C.

1208. Petroleum in Austria. H. Vetters and L. Waagen. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 35–39.—The Zistersdorf field, situated in the N. part of the Vienna Basin, is described. Both the Flysch, which is productive at Zissterdorf, and the Schlier, which many consider to be the source-rock, extend for long distances along the Alpine margin and the Alpine foreland, and they show many signs of petroleum. These areas therefore are prospective oil territory, and, indeed, commercial gas production has been obtained, notably around Wels and Lambach. In addition, the Schlier of the original foreland has been covered to a large extent by the Alpine overthrusts. It is probable that conditions in this buried Schlier are more favourable for the storage of large quantities of oil than in the present foreland. In the S. part of the Vienna Basin only gas deposits have as yet been found—*e.g.*, Oberlaa, etc. S. E. C.

1209. General Report for France. M. R. Schlumberger. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 41–48.—For the past few years the oil output of France has been very steady. The Pechelbronn field is the only field in production, and that has given 70,000 to 78,000 tons/year since 1921.

Oil shows are known in Alsace; in Franche Comté and Savoy, where the Vaux field has given 5,000,000 cu. m. of gas in 14 years.; in Languedoc, where the Gabian field has given 22,000 tons of oil in 12 yrs.; in Béarn and Gascony around diapiric folds, and lastly in the Limagne graben near the extinct volcanoes of the Auvergne. Tests have been made in all these areas, but seldom deeper than 3,200 ft. Geophysics has been used in the search for structures and for well correlation.

The drilling rigs were mainly of the rapid percussion type, but in recent years Pennsylvanian rigs and a heavy rotary have been introduced. All the wells are pumped, and electricity is used exclusively for this purpose, many of the pumps being operated automatically by the fluid level in the well.

Forty-five per cent. of the oil production is obtained by mining. The mining technique has been improved a great deal, and legislation and the quality of the oil have contributed largely to the commercial success of these methods.

G. D. H.

1210. Problems Raised by the Search for Oil in Italy. M. Gortani. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 49–54.—The following problems have been raised in the search for oil in Italy:

(*a*) Finding the limits of the gas-fields in folds beneath the alluvium of the Po valley.

(*b*) The age of the "scaled clay" in the "Apennin Emilien."

(*c*) The positions of oil accumulations on the Adriatic side of the Marche and Abruzzes Apennin.

(*d*) The existence of exploitable accumulations in the Latin valley.

(*e*) Search for oil accumulations in the Campano-Lucano Apennin, particularly in the outer zone between the Apennin and the Murge, which is probably less disturbed.

(*f*) Search for possible deep oil-fields in Sicily. The origin of the bituminous impregnations of the Pachino tufs and, subordinately, of the Raguse limestones.

Geological and geophysical investigations, and also deep borings which will go to depths of over 3000 m., are proceeding in an attempt to solve these problems.

G. D. H.

1211. Exploitation of Oil and Natural Gas in Poland in 1933-36. H. Tolwinski. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 81–100.—The Polish oil production fell from 550,000 tons in 1933 to 510,000 tons in 1936, due to progessive exhaustion of the fields, and in spite of greater drilling activity. In the same period the number of wells worked rose from 2794 to 3358, and the distance drilled from 66,901 m. to 107,001 m. Exploratory work has not been extensive as it ought to have been, for each year there have been only seven or eight exploratory wells in the Carpathians, none in the outer zone and two to five in the foreland.

The natural gas production is of interest, and if the output has risen merely from 462,000,000 cu. m. in 1933 to 483,000,000 cu. m. in 1936, this is due mainly to the lack of outlet, for the potentialities of the Daszawa and Roztoki fields are far above their present productions. The latter field is an indication of the great value of some of the regions in the central depression. Exploitation has begun at places such as Zagorze and Tarnava Dolna, and the recent discovery of the small Lipie Bed near Ustrzyki seems a good sign. There are interesting possibilities in the deep zone of Boryslaw.

Hopes are rising with regard to the foreland of the Carpathians, and especially of the eastern Capathians. The presence of diapiric structures can be taken as proved, in particular near Dolena, where a salt dome with oil was found in shallow wells.

There are graphs of production and activities at Boryslaw; tables of fields, production, state of wells, ozokerite output and exploratory wells, for the period 1933–1936. Drilling and production are described in a supplementary section by H. Gorka (pp. 97–100).

The bulk of the drilling is done with cable tools, but a few rotary rigs are in operation, mainly for exploratory drilling in the foreland. Steam engines supply the main motive-power, electric motors being very rare. Few wells erupt, and air or gas lift is not used extensively. The bulk of the wells are pumped. Various tables give statistics concerning the methods of drilling and recovery, and the outputs of the different companies.

G. D. H.

1212. General Report on Roumania. G. Macovei, A. Dragulinesco, D. Filipesco, G. Sava, T. Dobrescu, and others. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 101–182.—The report is divided into three sections—geology, drilling and production,

and refining. In the geological section the petroleum occurrences in the E. Carpathians and the principal fields there are described in some detail. Geological and geophysical prospecting in that area also receive mention. Then follows a short section on the Getic Depression, and another on the Transylvanian Basin.

Drilling methods, tools, equipment and casing are described, and particulars given of the various methods used for the identification and correlation of horizons, of cementation, of water shut-offs, etc. The production section commences with a detailed account of the characteristics of the producing horizons in the varicus fields, and this is followed by descriptions of the producing methods, demulsification and dewaxing. Further chapters deal with storage and transport, production and utilization of gas, specifications and organization.

The refining section opens with a general description and statistics. Then follow chapters on the distillation of crude under atmospheric pressure, on the manufacture of gasoline, gas oils and lubricating oils, asphalt and wax, and on cracking. Finally auxiliary plant and the quality of the crude and of its products are dealt with.

The report is well illustrated with diagrams, maps and tables. S. E. C.

1213. Search for Oil in French Equatorial Africa. J. O. Haas. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 183–189.—The history of the search is described briefly. Two basins of sedimentation lie between the coast on the west and the crystalline massif on the east. They are filled essentially with Cretaceous beds, and cover 60,000 km.^{2} At the base are the Ayem continental red beds (100 m.), followed by the N'Koyho Gocobeach bituminous series (Aptian, 300 m.), marine deposits containing some coarse sands and a basaltic conglomerate. Then comes a saliferous bed at the base of the Madiela calcareous series (Albian, 700 m.). The red Maningou beds (300 m.) show a return of continental conditions. Above is marine Turonian (100 m.) dominantly calcareous, followed by an important series of sandstones and bituminous shales (Namino-Komandji, 400 m.), belonging to the Senonian, silicified in parts and containing phosphate deposits in the Middle Congo. The Cirque series (Pliocene, 150 m.) rest uncomformably on the Cretaceous.

The basins are separated by a tongue, from the massif, and on the general seaward dip of the beds are superimposed folds and faults running between N.W.–S.E. and N.E.–S.W. Faulting is most common near the edge of the massif. Favourable structures sometimes emphasized by the presence of salt (Madiela) have been found in beds near to the crystalline massif.

The 2000 m. of sediments contain seven potential petroliferous series. In addition to these beds, which outcrop, there are many oil seeps, often associated with sulphurous springs and faults. Up to the present the findings have been very encouraging.

G. D. H.

1214. General Report on the Search for Oil in Madagascar. A. Savornin. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 191–195.—The search for oil has taken place in the sediment-covered western part of Madagascar. A series ranging from Permo-Triassic to Cretaceous covers the basement complex, and shows a slight, general westerly dip, on which there are broad flat undulations. There are many intrusions as dykes and in other forms.

There are many oil seeps, and early wells are reported to have shown signs of oil, but frequently they were poorly located. Intensive studies were made of the impregnated sands with a view to their distillation, but the costs were estimated to be prohibitive, and there were also technical difficulties.

Detailed investigations have been undertaken by the " Office National des Combustibles Liquides," the Government of the Colony and the " Compagnie Française des Pétroles," and drilling began in 1933. Two wells were drilled near Andrafiavelo on a Cretaceous dome, and were abandoned in igneous rocks. A third well at Tsimiror also reached igneous rocks, but found heavy oil impregnations in the sediments at three horizons between 15 and 480 m. deep. G. D. H.

1215. General Report on Morocco. R. Vigier, E. Lassauze, and J. Lacoste. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 197–207.—Numerous oil shows are found in N. Morocco, especially in the S. spurs of the Riff Mts. (the pre-Riffian zone). These

oil shows are divisible into two groups : those in the Liassic limestones near Meknes, and those (the more numerous) in Upper Cretaceous to Pliocene rocks in the Rharb. The geology of these areas is described. The first wells were drilled in the Rharb to test the Miocene. They were unsuccessful, but deeper drilling gave shows in glauconitic Oligocene sandstones. The Lias in the southern part of the Rharb was then tested, and this resulted in the production at Tselfat. As a result of this work, three horizons were discovered in the pre-Riffian Lias : the Toarcian and the Domerian at Tselfat and the Toarcian at Bou Draa. Work on the extension of these horizons to the N. is being carried out. Geophysical methods have been used. The seismic refraction method was tried, but was unsuccessful on account of the almost total absence of the sandstones supposed to exist at the base of the Miocene. Gravimetrical methods have been used on a large scale, and in most cases they have agreed with the results given by resistivity surveys. Dip shooting was attempted on two structures outlined by electrical surveys. It appears that in certain cases the marls, especially the Cretaceous marls, have a blanketing effect on the reflections.

Drilling methods are briefly described. S. E. C.

1216. Geological Conditions of the Search for Oil in Syria. L. Dubertret. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 209–211.—The search for oil in Syria began only 3 yrs. ago, and no well has yet been drilled. Except for an isolated example outside the zone of search, there are no seeps. The outcropping beds are Lower Fars, Upper Fars and Bakhtiari, and long folds or domes occur as in Irak ; but since lines of folding can break up basins of sedimentation into areas with different conditions, it is unwise to postulate the presence of oil by analogy with Irak. Large closed structures are known, and there are evidences of productive beds, suitable reservoir rocks and caprocks.

The salient points of the Cretaceous and Tertiary stratigraphy are indicated briefly. The question of source-beds is unsettled. Some geologists favour Cretaceous beds, others Tertiary, but there are some well-defined possible reservoir rocks in the Middle Eocene, Oligocene and Burdigalian. The marls of the Lower Fars, Upper Eocene, Oligocene and Burdigalian constitute suitable cap-rocks. G. D. H.

1217. Prospecting in Tunisia. A. Roux and M. Solignac. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 213–229.—Tunisia may be divided into six structural zones —the Neo-nummulitic sandstone zone, S. Tunisia, Central Tunisia, N. Tunisia, the Sahel zone, and the extreme S. of Tunisia. The predominating structural feature is that Tunisia is a land of domes, both of normal and of diapiric type. Indications of petroleum are frequent except in the Sahel zone and in the extreme S. They are associated with faults more or less related to the abnormal Trias contact, and they are found in all formations from Trias to Miocene.

The course of prospecting during the period 1894–1931 is reviewed. At the end of 1931 Le Syndicat d'Études et de Recherches Pétrolières en Tunisie was founded to undertake prospecting and test-drilling. The first work was carried out at Slouguia, where the structure is that of a diapiric dome, and is very complicated. Four test-wells have been drilled there, and although only traces of oil were obtained, the geological evidence was valuable. Drilling is at present suspended while a new programme is being considered. A deep well (1300 m.) was drilled on the Kef Bou Debbous anticline and reached the Upper Barremian, but without showing any signs of oil. There are seepages in the neighbourhood, and it was considered that reservoir rocks might be found in the Mid. and Lower Barremian and in the Hauterivian. The well was intended to test these possibilities. Another well on a dome at Djebel Ahmar also gave no signs of oil. The most promising results have been obtained on the Kebir anticline. A well drilled on this structure gave wet gas at 287 m. Other structures are being tested. S. E. C.

1218. Geological and Producing Activity in the Argentine State Oilfields in the Period 1933-1936. Anon. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 231–240.—Efforts in the period 1933–1936 in Argentine have been directed towards development of proved fields, and geological and geophysical investigations in areas where oil-seeps

occur. The outstanding event was the discovery at the end of 1935 of a new deep-producing horizon at Comodore Rivadavia. Producing horizons have been penetrated by wells in the Salta, Jujuy and Verra Cruz regions, but their value has not yet been ascertained. The extent of the producing horizons in the Neuquen district has been determined and an initial daily output of 600 brl. was obtained from the new wells.

During the period 1933–1936 180 out of the 792 wells drilled were exploratory wells. On the fields electricity is used exclusively, whilst for the exloratory wells diesel engines have replaced steam. After a short flowing phase, the wells are pumped (at the end of 1936 1597 out of 1747 paying wells were being pumped). At Plaza Huincul (Neuquen) gas-lift has been successfully applied.

Since 1916 various private companies have operated round the State fields. In the period 1933–1936 they produced 5,000,000 m^3. of oil, which constituted 46·4% of the country's output.

Numerous tables show details of the production and the state of the wells.

G. D. H.

1219. Petroleum and Natural Gas in Canada, 1933-1936. G. S. Hume, P. Rosewarne, and E. H. Wait. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 241–257.—During this period no new fields were discovered, but considerable advances were made, particularly in the knowledge of the foothills structures in Alberta. Drilling has proved an oil zone on the W. flank of the Turner Valley structure, and the better appreciation of this structure which has been obtained will have a direct bearing on exploration elsewhere in the foothills. Field studies in the Red Deer River area showed the existence of a fault which is steep in its upper part, flattens out, and then steepens again at depth. Such a fault would explain the production from the W. flank of the Turner Valley structure. Notes on other structures in Alberta and on other districts in Canada are given. The paper is illustrated by maps and statistical tables, and a few short notes are also given on drilling and production methods.

S. E. C.

1220. Petroleum Reserves of Peru. A. Cabrera La Rosa. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 311–314.—The development of the resources and of the mining laws is described. The Government reserves the right to retain any areas considered interesting, and it has conducted geological work in the province of Tumbes and around Lake Titicaca. A camp has been constructed 2·5 km. from Zorritos, and the first well had reached a depth of 444 m. in February 1937. S. E. C.

1221. Petroleum Industry in the North of Peru. O. Quiroga. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 315–317.—The first oil well in Peru was drilled in 1867. The Zorritos fields are worked by the Sociedad Anonima Commercial et Industrial, which has 395 wells on an area of 160 ha. and has produced over 400,000 tons of oil. 940 wells have been drilled by the Compagnie Petrolera Lobitos on the fields of Lobitos, Restin, Cabo, Blancq and El Ato. The output exceeds 5,000,000 tons from seven petroliferous horizons which are rich in high-pressure gas. The International Petroleum Co., Ltd., works the la Brea y Parinas concession, 2900 wells having been drilled on an area of 5200 ha. In 1936 the output was obout 2,000,000 tons. This last company has a large refinery at Talara. G. D. H.

1222. General Geological Report on the Oilfields of Venezuela. G. Zuloaga. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 319–326.—The greater part of the Venezuelan production comes from two Tertiary basins, the Maracaibo basin in the N.W. and the Maturin basin in the E. In the Maracaibo basin most of the present production comes from shore-line accumulations. Short notes are given on each of the fields in the two basins. Extensive geophysical work is being carried out in E. Venezuela to locate favourable structures in the Tertiary, and the results of a few test-wells indicate the possibility of E. Venezuela rivalling the western part of the country. Work along the foothills from E. Venezuela to Colombia points to the presence of the petroliferous formations at depth below the central and W. Llanos. Drilling is expected soon in the States of Guarico and Tachira. S. E. C.

1223. Recent Advances, Political and Geological, in connection with the Search for Oil in Australia. A. Wade. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 327–332.—Public and political opinion with regard to the search for oil in Australia have changed. The former has become more cautious, whilst recent Acts and Ordinances have been passed by various State, Territorial and Commonwealth Governments, in order to encourage and further the work of searching for oil in Australia and her dependencies.

The search is now being concentrated on five areas in Australia—the Great Artesian Basin, the Sydney Basin, the Gippsland Basin, the Desert Basin and the North West Basin. The geological conditions discovered in these areas and the results of drilling are briefly described. A little oil is being obtained from wells in the Gippsland Basin.

A short account is given of the state of the search for oil in Papua and New Guinea.

G. D. H.

1224. Progress Report on Bahrein Island. J. P. McCulloch. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 333–334.—The main producing horizon is a porous limestone, possibly of Senonian age, and the structure is an elongated dome. Initial well-head pressures are of the order of 475 lb./sq. in., and the reservoir is under hydrostatic control. The daily throughput of the refinery is being increased to 25,000 brls. A deep test is being drilled to search for possible deeper horizons. S. E. C.

1225. Description of the Kirkuk Oilfields. Anon. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 337–343.—The Iraq Petroleum Company, having the sole rights in the area on the left bank of the Tigris, has been able to carry out rational development of the fields. The period 1933–1936 was occupied in drilling enough wells to delimit the Kirkuk field and to provide wells for observing changes in reservoir conditions.

The geology of the region is briefly described. The main production is from structures where disharmonically folded beds cover a simple fold of the productive limestone. Three productive domes have been defined, the largest being 10 ml. long and 2 ml. wide. This structure is being exploited. The wells are 1·4—1·8 ml. apart and 400—1000 m. deep. They are not tubed.

The surface equipment is so arranged that gravity feed is possible throughout, the three degassing stations being above the wells. They are designed for dual or single-stage separation, and from them oil flows to the tank farm adjacent to the first pump-station of the trans-desert pipe-line. Undesirable constituents are removed from the crude in gaseous form in the stabilization plant and burned.

The rotary system has displaced cable tools, with steam as motive power. In some instances an oil-clay mud is used. G. D. H.

1226. General Description of the Iranian Fields. Anon. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 345–351.—The exclusive control of the Iranian fields held by the Anglo-Iranian Oil Company has permitted high efficiency in the recovery of the oil. The calcareous reservoir is both porous and jointed, the latter factor giving more regular productivity and allowing the pressure to be reduced below the gas saturation pressure with scarcely any increase in the gas–oil ratios. On account of the slowness of movement of water through the synclines, the fields are far from being under hydraulic control. Hence the preservation of the gas energy in the reservoir is essential. Special observation wells are drilled to facilitate reservoir control.

The disharmonic folding of the plastic Fars beds over the rigid Asmari limestone renders the discovery of new fields rather difficult.

The rotary drilling system is used generally, except for exploratory wells which are equipped with combination rigs. As far as possible, steam is used for motive power, on account of its flexibility, and the rotary table is driven by a separate engine. Three types of draw-works are in use, depending on the depth to be drilled. The equipment for pressure drilling is briefly described. G. D. H.

1227. Chemical Analyses of the Bituminous Substances in the Oligocene and Miocene Rocks of Poland. M. Kleinmann. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 355–359.—Over 6000 analyses of the bituminous matter in the Miocene series of the

Polish foreland, and the Oligocene rocks of the Carpathians have been made by a standard method. The following results have been obtained:

(*a*) In the Oligocene series the bituminous matter ranges 0·1–2·0% by weight. With a porosity of 15% there is visible oozing of oil only when the content of bituminous matter exceeds 2%.

(*b*) The marls and sandy clays of the Tortonian have 0·01–0·03% of soluble bitumen.

(*c*) The rocks of the Stebnick series are almost devoid of soluble bitumen (maximum 0·005%).

(*d*) Analyses of the extracted materials have revealed the presence of hard asphalts, resinous and paraffinous substances.

(*e*) There is no difference in composition (qualitatively) between materials extracted from the Oligocene series and those extracted from Tortonian beds.

G. D. H.

1228. Basic Problems of the Origin of Petroleum. K. Krejci-Graf. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 361–365.—The authigenic origin of petroleum is not supported by facts, and another explanation must be sought. The large quantities of hydrocarbons in an oilfield need not have been due to catastrophic causes, for the natural accumulation through the long periods of geological time would yeild quantities far in excess of those given by a catastrophy. There is no connection between coal and petroleum, and Potonié has shown that the formation of carbonaceous and bituminous rocks is different, even in the early stages. Two types of sediments give rise to bituminous rocks, Gyttja and Sapropel. Gyttja is found under aërobic conditions, so that the amount of organic matter preserved is small. Sapropel is found under anaërobic conditions where only anaërobic bacteria can work and even the easily destroyed albumen is preserved. Comparison of the elements present in petroleum and the various sediments shows that sapropels are much closer to petroleum than are other sediments in this respect. A theory of the origin of petroleum must also account for the accompanying phenomena. Oilfield waters are derived from marine organisms which may yield up to 80–90% water during decomposition, as well as various soluble salts. Paraffin oils increase in density with depth, since they lose their heavier constituents on upward migration. Asphaltic oils decrease in density with depth due to oxidation near the surface. Calcareous rocks seem to have particular influence in this respect. The action of bacteria on the initial formation of petroleum is being investigated. It is found that the lower alkanes occurring in petroleums have a toxic effect on these bacteria, so that their action beyond the initial stages in the formation of petroleum is improbable. Careful search of German oils and oil-bearing rocks showed them to be sterile. S. E. C.

1229. Physical Chemistry and the Origin of Petroleum. G. R. Schultze. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 367–370.—Whilst the source-materials of petroleum are in general agreed upon, the processes involved in their transformation are still a matter of doubt. The thermodynamic stability of the various hydrocarbons affords some indications of these transformation processes and the conditions under which they were operative. It has been shown that the commonest hydrocarbons in petroleum are the most stable thermodynamically. Paraffin base-oils are thus to be expected as the final product in the transformation series, since they are the most stable at low temperatures, and this agrees with Krejci Graf's "density law" and Hlauschek's "age law." Nevertheless, a transformation of higher paraffins to lower naphthenes is possible. The variations and distribution of the Upper Tertiary and the Palæozoic oils are shown to be in accordance with their thermodynamic characteristics. The hydrogenation theory is improbable on thermodynamic grounds unless polymerization is also accepted. S. E. C.

1230. Petroleum Cannot be Generated in Limestones. H. von Hettinga Tromp. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 371–381.—McKenzie Taylor's experiments have shown that the anaërobic action, which is essential for the preservation of the organic matter forming the main source of petroleum, can take place only under a layer of sodium clay which has been rendered impermeable by hydrolysis in fresh

water. The constituents which form the bulk of the Tertiary and Mesozoic oils—*e.g.*, the naphthenic and aromatic hydrocarbons, thiophenes, resins and hetero-cyclic nitrogenous compounds—show that the oils have arisen from vegetable remains, as also do their high optical activity and the identity of coal-bitumens and asphaltenes. The lighter paraffinic oils of Palæozoic are are most likely the cracked and hydrogenated derivatives of oils of similar origin to those of the Mesozoic and Tertiary.

The A.P.I. researches show that the organic matter in recent marine sediments is more than 60% of certain vegetable origin. Since the greater part of the remainder will disappear before oil is formed, the vegetable origin of oil is proved.

Limestones were deposited under strongly aërobic conditions, and therefore their organic matter can never have yielded oil. The so-called source-beds or asphalt horizons in limestones are impregnations by bitumen from outside sources.

The occurrence of gypsum, anhydrite and salt beds in association with oil-pools has nothing to do with the genesis of oil in limestones. It is merely an indication that in the strong sulphate solutions of desiccating seas, conditions were favourable for the development of sulphate-reducing bacteria and the methane producers of Barker, which together would be important in producing oil. G. D. H.

1231. Practical Problems and Scientific Basis of Micropalæontology. M. Glaessner. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 391–394.—Although micropalæontology has proved very valuable in petroleum geology, its use is mainly empirical, and the scientific basis of the subject has for the most part been neglected. As a result the full value of the subject is not obtained. Research on the distribution of the various species and on their evolutional history must be carried out in order that their value as zone fossils may be fully appreciated. The influence of facies, living conditions and surroundings is of the greatest importance, since it is possible for faunas of the same age to be very different from one another, and yet, on the other hand, some faunas of different age may be similar. Thus comparison of deposits of different facies can be made only by the use of species comparatively insensitive to their surrounding conditions. A bionometric analysis divides the various forms according to their habitat. For the foraminifera the following groups are suggested: agglutinative, planktonic, euryhaltic, sessile benthic and normal benthic. Such a study is of value not only for correlation, but also for the fact that it throws light on the conditions of deposition—an important factor in petroleum geology. S. E. C.

1232. Micropetrographic Methods as an Aid to the Stratigraphy of Chemical Deposits. M. W. Strong. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 395–399.—Micropetrographic methods have been employed in solving the stratigraphy of the poorly fossiliferous chemical deposits of Lower Miocene age in S.W. Iran. This problem is further complicated by the incompetency of the series.

The more general characters of the series show, in places, a similarity at points up to several hundred miles apart, whereas other specific characters are found to have an extent of only a few miles. By examining a large number of rock-cuttings it has been found that characters such as mineral types, texture, habit and inclusions can be employed as stratigraphical indicators. G. D. H.

1233. On the Existence, along the Northern Margin of the Pyrenees, of a Fore-deep of a Folded Chain such as those which have Given Rise to Numerous Classic Oil Accumulations. L. Bertrand and L. Barrabé. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 433–437.—The northern border zone of the Pyrenees shows, in its central and western parts, the features of the fore-deep of a folded chain. In the western part the Upper Cretaceous consists of over a thousand metres of Flysch, sandy at the base, calcareous and marly above. This seems to extend to the region of Saint-Gaudens "Petites Pyrénées." Farther to the east, beyond Foix, the Lavelanet well has penetrated 1150 m. of black marls and white micaceous sandstones, which are probably of Upper Cretaceous age. During Middle Eocene–Oligocene times the deposits of this deep were affected by important folding movements. In the west, in addition to strongly eroded regular folds, there are Keuper intrusions.

Oil-shows are frequent in the western part of this folded fore-deep. They occur on anticlines with Lower Cretaceous cores, and near Triassic intrusions, but wells

have shown no oil horizons in this area. The Lavelanet well found no certain oil indications, and the gas encountered was not necessarily from petroliferous beds. The central part, in which there has been no drilling, is nearer the oil-shows than the eastern part, and less disturbed and eroded than the western part. G. D. H.

1234. Structural Map of the Northern Part of the Pechelbronn Oilfield. R. Schnaebele and J. Walther. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 439–441.—Although the first wells were drilled in 1881, a permanent geological office was not established at Pechelbronn until 1913. The structure of the area has now been worked out in considerable detail, the studies having been greatly assisted by improved drilling methods and by the use of Schlumberger electrical surveys. A map has been compiled of the structure of the top of the Red bed, which is one of the best markers of the Oligocene. There is a general dip of 5–8° to the S.E., and this monocline is broken up into a series of compartments by longitudinal faults which trend generally N.N.E.–S.S.W. The eastern sides of the faults are uplifted, and the throw may be as much as 500 m. The fault planes dip at 40–65° to W.N.W. There are numerous transverse faults of which the throw rarely exceeds 50 m. and may vary or be reversed along a single fault. A single half dome form is known which is due to a series of small faults rather than to folding movements. The structural map drawn up will be of great value in deeper exploration.

A map of part of the area is given. G. D. H.

1235. General Characters of the Palæogeography of the Prerifian Lias in Relation to the Oil-bearing facies. J. Gubler. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 455–465.—The palæogeography and the facies of the different areas of deposition in Pliensbachian, Domerian and Toarcian times, in the Prerifian region, are described in detail. This description is illustrated by a tectonic sketch, cross-sections, diagrams showing the types of sedimentation along various lines, maps showing the distribution of facies and there is a stratigraphical table for the different areas. G. D. H.

1236. Study of Post-Jurassic Formations and the Distribution of Oil Indications in the Ouest Prerifian. M. Rey, V. Ostrowsky and N. Gouskov. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 467–473.—The numerous oil indications of the Cretaceous, Nummulitic and Miocene series of the Ouest Prerifian zone have led to prospecting.

The facies of the post-Jurassic deposits show little variation. They consist of thick series of marls and flysch with occasional ophilics. The extreme scarcity of macro fossils has caused the stratigraphy to be based on foraminifera, and these have permitted the differentiation of marly series of different ages which can be confused due to recurrence of similar facies. Stratigraphical columns have been constructed, based on small foraminifera for the marls, and on Orbitoides and Nummulites for the flysch. These columns are comparable to those established in America, in particular in the region of the Gulf of Mexico, and in Venezuela.

Several sedimentary cycles, separated by orogenic phases, have been demonstrated. These cycles are Cretaceous, Nummulitic, Lower Miocene, Upper Miocene and Latest Miocene in age.

Stratigraphical tables for the different areas and tables of the stratigraphical distribution of the foraminifera are given. G. D. H.

1237. Structure of the Rharb Region. M. Tenaille. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 475–479.—During Upper Cretaceous, Nummulitic and Lower Miocene times this region was in the middle of the Pre-Riffian trough, between the Meseta of Rharb (Primary massif) and the Riff chain, which was then in process of formation. The thick, plastic cover of young sediments resting on rigid Jurassic and Cretaceous beds has determined the tectonics of the region. In this cover, which alone is visible in the region studied, large asymmetric synclines can be delineated between Cretaceous anticlinal cores, associated with salt-bearing lenses. The whole is much compressed.

The oil indications associated with the formations of different ages, are connected with the anticlinal axes. G. D. H.

1238. Bituminous Facies of the Moroccan Palæozoic. B. Yovanovitch. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 481–484.—The structures of the Palæozoic basement in the regions on each side of the Casablanca meridian are quite different. One area includes beds from Georgian to Gothlandian age, whilst the other shows Ordovician to Carboniferous marine formations. The problem of oil occurrence in Morocco is bound up with the contact of Mediterranean geosynclinal deposits and the basement. Where the basement outcrops, it shows three main structural trends: N. 10–15° E., N. 60–70° W. and N. 40–50° E. It is probable that these trends continue under the Prerifian. The basement possesses bituminous facies, especially in the Gothlandian (Tizi N'Laafit carbonaceous shales, Tamdrost strata, etc.).

The Visean lies transgressively on Lower Palæozoic beds, and whilst beds of Trenton age appear to be missing, this does not seem to be the case for beds of Pennsylvanian and Mississippian age.

Although the author does not conclude that the Liassic oil of Morocco had its source in the Gothlandian or Devonian, he believes that oil from such a source may be found below the Visean. A single well would probably be very informative with regard to the possibilities of the Georgian. G. D. H.

1239. Pissasphalte of the Bône (Algeria) Region. L. Joleaud. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 485–486.—Pissasphalte is found sporadically on the shore in the region of Bône. To the east and to the west, towards Djidjelli and Tabarka, Eocene limestones on the coasts of N.W. Tunis and N.E. Algeria show thin bituminous beds. The traces of bitumen in the Eocene of the Bône region appear to be intimately associated with tectonic movements.

The Eocene outcrops extensively on the island of Galite, which is structurally similar to the Edough dome of the Bône area. Undoubtedly submarine oil seeps occur between La Galite and the eastern coast of the Department of Constantine. G. D. H.

1240. Petroleum Possibilities in Belgium. A. Renier. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 487–492.—The geology of Belgium is so well known by reason of intensive mapping, boring and mining that the chances of discovering petroleum now are small. The best chance lies in the Dinantian limestone, and even in that case the associated conditions are such that prospective areas are few and limited in extent. The chief causes of these unfavourable prospects are the geological history of Belgium and its situation in a geanticlinal zone. S. E. C.

1241. Neogene Stratigraphy of the Intra-Alpine Vienna Basin and its Relationship to Oil-bearing Horizons. D. Andrusow. *II^me Congrès Mond. Petrole*, 1937, **1** (Sect. 1), 493–497.—The discovery of oil at Gbely in 1914 suggested the possibility of the presence of oil in the Neogene beds of the whole intra-Alpine basin of Vienna. Although this is taken as the type area, its Neogene stratigraphy is still a matter of discussion. Recent studies have permitted the succession in the Czecho–Slovakian part of the Vienna basin to be determined as follows:

Burdigalian: contains conglomerates and sandstones with a marine fauna, which transgress on to the Cretaceous of the Brezovo mountains near the south-eastern edge of the basin.

Helvetian: Schlier, sometimes going over to a kind of flysch fills the eastern part of the basin in Slovakian territory and stretches to the Gbely area.

On these lie the Tortonian, Lower Sarmatian and Congeria beds of the Meotian or perhaps the Upper Sarmatian. Oil horizons occur in the Sarmatian and to some extent in the Tortonian. The oil may have been formed in the Neogene, or may have migrated from the Palæogene, which shows traces of oil in places. Chemical differences in the Neogene and Palæogene oils have led to suggestions that they have different sources. Certain facts point to the Vienna basin oils have arisen from Palæogene oils rather than from the Schlier. G. D. H.

1242. Productive Petroliferous Region in the N.E. of the Great Hungarian Plain. L. de Loczy. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 499–507.—The Bükkszék

field came into production early in 1937. Accumulation is in the central part of a much-fractured dome some 4 km. long and 1½ km. wide, and the reservoir rock is a fissured, andesitic tuff intercalated in the impermeable Kiscell clays. There are three producing horizons, of which the second is the richest. As these horizons are relatively shallow, hopes are entertained of finding deeper and richer zones.

Exploration carried out by de Böckh during the period 1913–1932 was directed chiefly towards determining the possibilities of the Great Plain, on the basis of the theory that the Miocene salifère formation is a source-rock and is present there. Deep tests were drilled on prospects outlined by geophysical surveys, but with no practical results. Since 1932 attention has been focused on the mountains around the margin of the Plain, and numerous oil-shows were soon discovered. The Kiscell shale (Oligocene) is the most important formation from the point of view of source-rocks, although it is possible that the underlying Triassic and Carboniferous sediments may also have yielded petroleum. The Oligocene area which passes through Bükkszék is dominated by fault structures. Folding is mainly in a W.S.W.–E.N.E. direction. Beside the present field at Bükkszék, other large structures have been mapped, but have not yet been tested. The Plain also has not been thoroughly explored, and further work will be carried out.

A short account of the palæogeography and tectonics of Hungary is given.

S. E. C.

1243. Origin of Salt Intrusions and the Possibility of them being Petroliferous. O. Barsch. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 509–513.—The main theories are reviewed. Both tangential pressure and the weight of the over-burden have undoubtedly played their part in the formation of these structures, the relative importance of these two components varying in different cases. In every case, however, a local zone of weakness in the rocks covering the salt is essential. The various cases in which such a zone of weakness is developed are then discussed and the conditions under which the salt will rise are indicated. These conclusions are applied to the Hanover salt masses.

Petroleum is formed in bituminous strata and, under the effect of pressure and heat, will accumulate and migrate upwards. If these strata are inclined and also covered by impermeable beds, then large quantities of petroleum will accumulate at the highest point. On this basis the various types of salt structures previously outlined are examined, and the possibility of obtaining commercial production from them is indicated, both for the case of pre-Salt and post-Salt source-rocks. S. E. C.

1244. Residual Salinity of the Miocene Marls of the Transylvanian Basin. L. Mrazec. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 515–518.—This basin within the Carpathians was outlined in the Oligocene and accentuated in the Neogene. The sedimentary infilling involved a subsidence of 5000–5500 m. The Miocene consists of Sarmatian marls with interbedded sands and volcanic tuffs (1500 m.) resting on over 1000 m. of clay marls of Mediterranean age. The Pliocene is mainly sandy. The Sarmatian is the gas-bearing formation, yielding almost pure methane in association with fossil brines. The various wells drilled have permitted a study of the salinity of the Sarmatian and Mediterranean to a depth of 3000 m. After taking due precautions, the cold water extracts of the cores have shown salt contents of 0·2–0·8% of the marls (exceptionally 1·0%).

Mediterranean marls from a quarry showed a similar salt content. It must be noted that the gas-bearing areas are well away from the salt zone of the basin. The salt in the Miocene is considered as residual. It is possible that some of the gas and the salt waters may come from the Mediterranean marl complex. G. D. H.

1245. Bucsani Oilfield. D. Stefanesco. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 519–526.—The Bucsani anticline is developed in the sub-Carpathian Mio-Pliocene zone in which are found the diapiric folds. The only surface indication of the fold is a gentle undulation in the Levantine. The general trend is E.–W., and the fold is cut by three faults, of which the most important cuts right across it in the S. Details are given of the stratigraphy which includes the Levantine, Dacic, Pontic and Meotic. The core of the fold is composed of Helvetian deposits and of salt. Some wells on

passing through the Meotic have entered massive salt, whilst others have entered the Helvetian. There is a Dacic gas zone in the crestal part of the structure, and three sandy horizons in the Meotic which are oil impregnated. Of these Meotic horizons the second gives no production, and the first is only productive in the axial part of the structure. The main production is from the third horizon. Some production figures are given. Initial bottom-hole pressures were 150–180 atmos. with a G.O.R. of 200. With a fall in bottom-hole pressure the G.O.R. has risen in some cases to as much as 1000. Well spacing is at a minimum of 200 m. Production methods are described briefly. S. E. C.

1246. Saline Waters of the Roumanian Oilfields. P. Petrescu. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 527–536.—The liquid and gaseous hydrocarbons in Roumania are nearly always accompanied by saline waters. These waters do not circulate, and are derived from a number of sources: connate water, the water contained in entombed organic matter, etc. Their composition varies during their history on account of solution, base exchange and other factors. The iodine and bromine content is usually high, whereas the sulphate content is in general negligible or nil. When sulphate is present it is due to admixture with surface waters. Naphthenates may be present in waters in contact with petroleum, the amount varying with the degree of oxidation of the oil. The reaction is between the naphthenic acids and the bicarbonates of the alkaline earths, and possibly also calcium and magnesium carbonates in the reservoir rocks. Ammonia is present in all the Roumanian brines, probably as ammonium chloride. The Oligocene brines contain the smallest amounts of ammonia, whilst the Meotic and Dacic have the highest content. The consideration of many analyses leads to the conclusion that these brines are not merely seawater in which alteration by dilution or concentration, removal of sulphates, and replacement of the magnesium by calcium has taken place.

Tables giving detailed analyses of many samples and a table comparing the ammonium and sulphate contents of some brines are appended. S. E. C.

1247. Possibilities of Oil Accumulations in the Miocene of Poland. O. W. Wyzynski. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 557–542.—Recent geological and geophysical investigations in the Miocene basin of the foreland of the Polish Carpathians indicate the possibility of discovering new oilfields. The Miocene series, which has similar characteristics to the oil-bearing series of the Vienna basin is in three units.

1. The peri-Carpathic saliferous zone may yield fields of the Boryslaw type, but their location is rendered difficult by the tectonic complexities.
2. The folded zone of the Stebnick series is not viewed favourably, for the structure is against large accumulations, and no seepages have been observed.
3. The external zone of the Tortonian series seems likely to provide oilfields in the near future. In this zone lie the important gasfields of Daszawa. The gas shows hydrocarbon homologues up to butane. Hydrocarbons have been found in the Tortonian, not only in the foreland of eastern Poland, but also in the foreland of the western Carpathians. G. D. H.

1248. Micropalæontological Researches in the Foreland of the E. Carpathians (Poland). T. Chlebowski and J. Czernikowski. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 543–545.—Micropalæontology has shown three key horizons in the foreland series, and with this aid the foreland has been divided into three zones: east, middle, and west. A table is given showing the characteristic foraminifera in the various beds in these three zones. S. E. C.

1249. Petroleum in the Polish Carpathians. G. Strzetelski. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 547–553.—The geology of the Polish Carpathians is described briefly, and then the possibility of finding new fields is discussed. The Central Depression is a basin analagous to the Ploesti Basin in Roumania. It is crossed by seven principal folds, which are frequently broken by transverse and parallel faults, and which plunge gently eastwards. The Ciezkowice sandstone, an important reservoir rock, should be found at a depth below more recent deposits in the eastern part

of the Depression. In the folded region to the N. the Ciezkowice sandstone is absent, but petroleum is found in the sandstones in the Menelite Shales, as at Wankowa, and in the Eocene sandstones, as at Witrylow. These folds plunge into the Strzyzow depression in the W., and drilling in this area on the fold axes should show whether deposits of the Wankowa–Lodyna type are present. S. E. C.

1250. Epeirogenic Dips in the Foreland from the Point of View of Oil Exploitation in the Sub-Carpathian Zone. W. Teisseyre. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 555–558.—It appears from an epeirogenic synthesis of the foreland that the main petroliferous areas of the margin of the Carpathian Flysch zone, Boryslaw and Majdan, are situated near the axis of flat trans-Carpathian geanticlines, Gologory–Krzemieniec and Kewalowka–Smykewve, which embrace a segment of the Polish Eastern Carpathians. The slopes of their flanks are gentle everywhere. There are, however, deep depressions of the basement, which affect the flanks. In these depressions lie the crests of peri-Carpathian arches of the basement, and since these are covered by great thicknesses of deposits, they must be located by deep wells in order to test them for oil. The search can be facilitated by a study of the epeirogenic dips of the outermost foreland, where the outcrop of the sub-Carpathian basement forms the Podolian shelf. The epeirogenic deformations of the peri-Carpathian basement can be correlated with those of the Podolian area. G. D. H.

1251. Geology of the Albanian Petroleum Deposits. L. Maddalena and S. Zuber. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 559–579.—The history of geological studies in Albania is reviewed, and then follows a detailed description of the geology of the country and of the petroliferous areas. Albania may be divided into two geological divisions: the zone of nappes and the autochthonous zone. With the exception of some gas and insignificant shows of oil, all the known occurrences of petroleum are in the folds of the autochthonous zone. Indications are common in the Flysch and the Schlier, but generally prove to be dry, an exception being Drasciovitza, E. of Valona. The main producing horizons are in the Miocene, and the principal areas are Selenitza-Pahtos (N.E. of Valona), the Devoli basin (Kuciova, N. of Berat), and Greshitza (N.E. of Valona). Of these the Devoli basin is the most important. The subsurface structure there is a buried, strongly eroded anticline of Cretaceous limestone with Eocene limestone at least on the E. flank. Above this are all stages of the Flysch and Schlier, and then follow the Miocene and Pliocene, which fill the basin. The structure in the Mio-Pliocene is in general monoclinal. The basin is crossed by a network of faults, and their effect is greatest near the margin. There are three divisions of the Miocene, Kuciova series (upper), Gorani series, and Driza series (mid Miocene). All are petroliferous, although commercial production from the Driza series is limited to a small area. The main production is from the Gorani series, and the oil is asphaltic with sp. gr. 0·930–0·940 and 3–4% sulphur. S. E. C.

1252. Exploitation Geology at Devoli (Albania). G. Ineichen. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 581–586.—A description of the work of the exploitation geologist at Devoli. It includes particulars of the organization of the staff, methods of taking, storing and examining samples, the preparation of profiles, and various special tasks such as porosity determinations and analyses of brines, impregnations, etc. S. E. C.

1253. Prospecting in the Fossa Bradanica, S. Italy. C. Migliorini. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 587–591.—The area considered is a Pliocene outlier lying between the Apennines on the W., the Gargano promontory on the N.E., and the Murge Hills on the S.E. Prospecting was undertaken because of the numerous oil shows in the S. Apennines, the favourable lithological conditions, the probability that pre-Pliocene Apennine formations would exist under this Pliocene outlier and be considerably less disturbed than in the Apennines themselves, and because the Pliocene rocks would afford excellent cover for any oil deposits below. A summary is given of the geological investigations which have been carried out and which have been supplemented by seismic (refraction) surveys. A well is being drilled near Genzano to give further information. S. E. C.

1254. Petroleum Exploration in the Dahalac Archipelago (Red Sea). L. Maddalena. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 593–597.—The Dahalac archipelago and the Farisan isles are the visible parts of two parallel submarine ridges which run down the middle of the Red Sea off the Eritrian coast. Shows of oil and gas have been seen around the Dahalac isles, and an expedition was sent to investigate the petroleum possibilities. The structure is dominated by faults, and the explanation put forward involves a salt mass which exerted upward pressure on the limestone until the salt itself reached a sufficient height for solution to become active. Foundering then took place. The programme of work, including geophysical surveys and core-drilling necessary to verify this hypothesis is outlined. A boring was put down on Dahalac Island, and reached salt at 299 m. S. E. C.

1255. General Tectonics and the Sources of Oil on the Land and in the Sea of Oman (Arabia). L. Joleaud. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 599–600.—An important oilfield has lately been discovered on Bahrein Island in the Persian Gulf. Recent oceanographical expeditions have found seepages of oil in the Gulf of Oman off the eastern coast of Arabia. These oil-bearing beds are situated in the same tectonic area on the fringe of the virgation of the Alpine folds of Irak and Iran. They are part of the oil accumulations which have been collected in the zone of interference of the Tertiary folds of western Asia, and the Arabian–East African tectonic features associated with the old Uralo-Mozambique geosynclines (Caucasus, Iraq, Iran, Oman). G. D. H.

1256. Hydrocarbons in the Orange Free State. O. R. van Eeden. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 601–607.—Solid and liquid hydrocarbons have long been known to occur in the Stormberg lavas of the Karroo system, and in certain dolerite dykes intrusive into this system. They have been noted at various points in the Harrismith and Bethlehem districts, and have led to some ill-conceived drilling.

In the basalts the hydrocarbons occur, partly filling amygdales, and sometimes they are associated with a black silicate allied to hisingerite, but no genetic connection between the two has been proved. Hydrocarbons occur in the sediments only in the neighbourhood of dolerite dykes. It is believed that the hydrocarbons were present in the dolerites when they were intruded. The hydrocarbons may have been formed from organic matter in sediments encountered by the dolerites, or they may be of inorganic origin. The hydrocarbons have no economic value, and cannot be considered as indications of accumulations of petroleum. G. D. H.

1257. Productive Zones of Mexico. E. D. Lozano. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 613–617.—There are three productive zones in Mexico. The North-eastern is the southern continuation of the Texas Gulf Coast, and is separated from the second zone by the Sierra de Tamaulipas. Natural gas in commercial quantities is found in the Tertiary, and the Cretaceous may prove to be productive. The second zone is bounded on the W. by the Sierra Madre Oriental, and it includes the Panuco and Tuxpan areas. The main production is from the Cretaceous. The third zone is the Isthmus of Tehuantepec, and the production is from the Miocene. Salt structures are found in this area. S. E. C.

1258. Cross-section through the Petroliferous Zone of N.E. Mexico. W. Staub. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 619–622.—The geology is described briefly, and a series of cross-sections and a geological map are given. S. E. C.

1259. Oil in Peru. A. Jochamowitz. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 637–642.—The exploitation of oil in Peru has been confined to the north-west, of which the geology, structure and geological history are described. Except for the Pliocene, oil has been found in each of the stages of the Tertiary, but the horizons in which it is found are not necessarily those in which it was formed. In general, it occurs in thin small lenticles, which renders the location of wells rather difficult.

Oil has also been found in wells which have been drilled in the lake Titicaca region, and it has been suggested that some of it is in beds of Jurassic age. In the Amazon

region it is believed that the Cretaceous beds may yield oil accumulations, but no wells have yet been drilled. G. D. H.

1260. Tectonics of the Oil-bearing Tertiary in North-west Peru. G. Petersen. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect 1), 643–648.—The views of various writers on the tectonics of N.W. Peru and S.W. Ecuador are examined in detail, with special reference to such features as the clay pebble bed and the Pacific fault. It is suggested that the idea of a N.W. Peruvian geosyncline, must be replaced by one of a complex shelf. G. D. H.

Geophysics.

1261. Anomalies in the Horizontal Gradient of "ρ" at the Junction of the Sub-Carpathians and the Roumanian Plain from the Point of View of the Search for Oil. I. Gavat. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 683–694.—The results of gravimetric investigations at the junction of the sub-Carpathians and the Roumanian plain are summarized, and a map and diagrams are given which embody the structural features and the variations of "ρ." Regional tendencies have been estimated, and thus the local anomalies become apparent. In general, a local maximum or minimum corresponds with the axis of a fold, but the decision as to whether it is anticlinal or synclinal can be reached only from stratigraphic considerations, and from comparison with the results for adjacent known structures. A line through Viforâta, Mârgineni, Aricești and Boldesti separates a northern zone where local influences predominate from a southern zone where regional influences predominate. G. D. H.

Aerial Survey.

1262. Aerial Survey in Exploration Work. B. Scherpbier and J. Krebs. *J. Instn Petrol. Tech.*, 1938, **24**, 225–232.—This paper discusses the methods of Aerial Survey and describes how aerial photography has assisted the exploration geologist. D. L. S.

1263. Aerial Geological Exploration of Presumed Petroliferous Structures in Tunis. M. Solignac. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 427–432.—The Dj. Zaouia anticline near Hadjeb el Aioun runs N.E.–S.W. for 20 km., and is 0·5–1·0 km. wide. It is formed wholly of Cenomanian beds in which some indications of hydrocarbons are found. Due to low dip of the beds and recurrence of facies, such features as faults are not easily traced. They are not shown on the usual geological maps, nor are they apparent on the topographical maps, although both have been prepared with great care. The use of an aeroplane has cleared up these difficulties. Photographs were taken of the whole anticline from a height of 2600 m., and joined up to give a map on a scale of 1 : 10,000. This map revealed several "highs" on the undulating longitudinal axis, in addition to faults, and has permitted the highest crest to be selected and enabled a well location to be chosen where there is least likely to be disturbance due to faults. G. D. H.

1264. Use of Aircraft for Geological, Hydrological and Mining Cartography in Tunis. E. Berkaloff. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 401–409.—Conditions in Tunis are ideal for the use of aircraft for geological surveying, for the outcrops generally correspond with well-defined topographical features; the flora is closely allied to the rock types; the vegetation does not hide the ground when viewed from the air; good topographical maps are available. The aerial photographs taken in geological surveys in Tunis have not aimed at geometrical exactness, but at a ground-picture of maximum clarity and completeness. On this account the geologists do not need an expensive photogrammetric apparatus, and for compiling maps it has been possible to use simple methods and avoid elaborate material. Visual survey is not suitable for exact mapping, but it is useful for sketches and rapid-exploration. Aerial surveys must be controlled and completed by ordinary field work.

The most interesting results of the surveys have been the location of faults, many

of which could not be readily seen on the ground. Hence they may be useful in locating hydrothermal mineral deposits or the sites for oil or water wells where these materials are known to be intimately associated with faults.

The costs of aerial surveys, which are complementary to ordinary field work, and the interpretation of which is not always obvious without the latter, may be kept within reasonable limits by the careful choice of photographic materials, and by having a crew consisting of pilot, cartographer geologist and observer geologist.

G. D. H.

Drilling.

1265. Determining Suitability of Cement for Oil Well Cementing. J. E. Weiler. *Petrol. Engr*, Sept. 1938, **9** (13), 33.—Cements are being manufactured which are especially adapted to the several general types of cementing jobs. Among the factors determining the suitability of a cement for a particular job are: (1) time required to attain a consistency beyond which the cement would be no longer pumpable under average conditions; (2) the consistency during the pumpable period as defined in (1); (3) the effect of temperature on the length of the pumpable period; (4) the rate of attaining strength after being placed; (5) the ultimate strength of the cement and (6) the effect of temperature on the rate of attaining strength and on the ultimate strength.

A method is described for testing oil-well cement that employs a consistometer, and this method is advanced as practical for field use with particular reference to temperature and consistency. L. V. W. C.

1266. Determining the Filtration Characteristics of Drilling Muds (Part I). H. D. Larson. *Petrol. Engr*, Sept. 1938, **9** (13), 42.—The methods of ascertaining the relationship of water loss and cake thickness to time, temperature, pressure, composition of mud, solids content of mud and type of filtering medium are described.

L. V. W. C.

1267. Refined Testing Methods at Well Improve Mud Control. W. A. Sawdon. *Petrol. Engr*, Sept. 1938, **9** (13), 80.—Several major companies in California have designed portable cabinets for field-testing equipment for mud testing, which are set up at each drilling well. A completely equipped cabinet provides a small laboratory at the well. It is set up near the mud ditch and offers a means of maintaining close control of the drilling-fluid. It is equipped with air and water connections and electric light. Samples of mud to be tested are taken from the mud stream and placed in a bucket hung on the bottom of the cabinet. A Marsh funnel and stopwatch are provided for viscosity determinations. The weight of the fluid is measured by a Brown "mud water" hydrometer, and a special elutriation tube is used for measuring the sand content. A stopper graduate is provided for making settling tests, whilst wall-building property is measured by a filter press. L. V. W. C.

1268. Alaskan Well Has Oil Showing. W. A. Sawdon. *Petrol. Engr*, Sept. 1938, **9** (13), 85.—The only well in Alaska drilling in or near a prospective oil zone is the Imskin Drilling Company's well. Another test is reported to be drilling at 1000 ft.

The Imskin well is situated 6 miles from Illiamna Bay, and possibility of oil production is indicated. The well is now closed in for the winter. The depth reached is 7156 ft. L. V. W. C.

1269. Central Steam Unit Used to Drill Wasco, California, Properties. T. P. Sanders. *Oil Gas J.*, 4.8.38, **37** (12), 38.—Interest in the Wasco field of California has been centred primarily in equipment. Most conspicuous is the small three-boiler steam plant, which is located fully 1800 ft. from the derrick. Using this plant, a depth of 9813 ft. was reached in 30 days, which included 5 days' lost drilling time due to cementing surface pipe at 500 ft. and intermediate string at 5500 ft. The boilers are placed at a distance from the derrick to enable them to supply steam for seven or eight wells from their present position. This plant was located by seismograph survey, and was placed as near the apex of the subsurface structural dome as possible.

A 40-acre spacing programme will be used in this field because of the expense of drilling. There is only a 10-lb. pressure drop in the steam supply line under normal operating conditions, and even under abnormally high steam demand the pressure drop seldom exceeds 15 lb.

The mud is handled by three pumps, two of which are direct-acting slush pumps and the third is a power-driven pump. L. V. W. C.

1270. Gel-Forming, Retarded Cement Found Successful in East Texas. G. Weber. *Oil Gas J.*, 11.8.38, **37** (13), 50.—An important problem, and one contributing to the pressure production relationship in the East Texas area, is that of continued rise in salt-water production.

Among new developments in the curtailment of water withdrawals is an increase in plug back programme and an improved technique in high-pressure squeezing made possible by the use of new gel-forming retarded cements.

The gel action of the new slurry mixes gives the cement in the hole more body, preventing it from channelling, and a pressure build up of 2500–3000 lb. is now the rule rather than the exception, as was the case previously. Pressures up to 6000 lb. have been obtained on some jobs.

Squeeze jobs have been simplified by the improved cements. L. V. W. C.

1271. Rotary Drilling in the Appalachian Area of Pennsylvania. J. F. Robinson. *Oil Gas J.*, 11.8.38, **37** (13), 59.—It has been proved that rotary can drill any portion of the geological section encountered in the Appalachian area, and with the exception of the cherty portion of the Onondaga, the drilling can be done more rapidly than with cable tools. Gas pockets and caving formations can be combated by the rotary, and the system is without doubt considerably faster than cable tools. It is more expensive on a per-foot basis, but it must be considered that the use of rotary in this area is as yet in the experimental stage, and there is no doubt that costs can be considerably reduced. L. V. W. C.

1272. Continuous Determination of Oil and Gas Contents of Drilling Mud Helpful. B. Mills. *Oil Wkly*, 1.8.38, **90** (8), 18.—A continuous-drilling mud analysis for determining the presence of gas, oil and salt water in formations drilled has been developed by Barnsdall Oil Company. This is being used as an adjunct to regulation core and logging data.

Each mud sample is tested for gas, oil, salt water and viscosity, and by plotting a log showing depth of hole, viscosity change of mud and percentage of gas, it is possible to pick up significant formations.

The method is explained in detail. L. V. W. C.

1273. Hold-Ups Prevent Wear on Central Power Take-Offs. R. L. Dudley, Jnr. *Oil Wkly*, 1.8.38, **90** (8), 32.—Hold-ups of the proper elevation and which allow for the lateral motion of the rod from the power have reduced expense through wear and tear on power take-offs.

These hold-ups are made easily from pipe and T-joints. A roller is placed on a 2-in. shaft between two T-joints, and the take-off rod rests on the top of the roller. L. V. W. C.

1274. Small Hole Drilling Holds Wide Possibilities. (Parts I and II.) B. Mills and F. B. Taylor. *Oil Wkly*, 8.8.38, **90** (9), 22; 15.8.38, **90** (10), 26.—Small exploratory and development holes are being drilled successfully, with the range of operations extending from deep wild-cat tests to actual completions in shallow territory. This new phase of development work holds wide possibilities, as both time and cost factors are affected favourably by small-hole drilling. At the same time the practice has its limitations. It offers an excellent exploratory medium ahead of intensive field development.

The first article discusses the economical and geological angles of small-hole drilling, whilst the second describes advancements in machinery that have gained popularity for small-hole drilling. L. V. W. C.

1275. Derrick Skidding Now Highly Skilled Art. B. Mills. *Oil Wkly*, 22.8.38, **90** (11), 18.—An efficient derrick skidding method has been developed by Humble Oil & Refining Company, with the movement of the erected derrick and substructure as one unit. The use of special skid shoes designed for the reduction of friction, heavy tractors for pulling the derricks, and simple well foundations have made an easy job of transferring a derrick intact from one location to another. Two types of skids have been developed.

The Christmas trees at producing wells are completed low enough to permit skidding the derrick floor over the floor assembly. The time saved by skidding a derrick is a substantial item. L. V. W. C.

1276. An Open-Hole Cementation. W. Darling and G. Cotton. *J. Instn Petrol. Tech.*, 1938, **24**, 233.—This describes an unusual method for shutting off water in drilling for oil. D. L. S.

1277. Living Accommodation at Exploratory Wells. M. Debregeas. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 869–872.—The various types of huts, etc., for such purposes are described, and their advantages and disadvantages enumerated. Many types were tried in Morocco, and it was found that the best was a small portable building which could easily be moved from one location to another, and which merely required a rough levelling of the ground for it to be set in position. Each workman has a hut to himself, and they are spaced so that men on different shifts do not disturb one another. S. E. C.

1278. Drilling Patents. C. B. Grant U.S.P. 2,127,728, 23.8.38. Method of and apparatus for completing wells under pressure.

R. P. Sherman. U.S.P. 2,128,102, 23.8.38. Releasable overshot.

G. W. Woods and H. B. Woods. U.S.P. 2,128,111, 23.8.38. Welded tool joint.

T. A. Creighton. U.S.P. 2,128,352, 30.8.38. Method and apparatus for releasing fluid from drill-pipe.

A. C. Catland. U.S.P. 2,128,401, 30.8.38. Roller-drill mounting.

J. H. Howard and A. C. Catland. U.S.P. 2,128,416, 30.8.38. Reamer cutter mounting.

E. E. Pryor. U.S.P. 2,128,430, 30.8.38. Fishing tool.

A. J. Neff. U.S.P. 2,128,712, 30.8.38. Portable rig-gin pole.

W. E. Burke and M. I. Works. U.S.P. 2,188,914, 6.9.38. A core-drill and core-barrel assembly.

M. O. Johnston. U.S.P. 2,129,216, 6.9.38. An equalising valve for oil-well tools.

J. W. MacClatchie. U.S.P. 2,129,433, 6.9.38. Rotating blow out preventer.

J. B. Newsom. U.S.P. 2,130,192, 13.9.38. A device for straightening a bore hole comprising an upwardly converging core drill, a drive shaft secured to the upper end of the drill, a spider journalled on the drive shaft for holding the shaft in a predetermined alignment within the hole to be straightened and a means for holding the main drive shaft in central alignment.

J. Buckles. U.S.P. 2,130,580, 20.9.38. Inside pipe cutter.

J. J. Kane. U.S.P. 2,130,587, 20.9.38. A pipe-joint for well casings comprising a bell and spigot connection. L. V. W. C.

See also Abstract No. 1212.

Production.

1279. Well Studies as a Practical Production Procedure. Anon. *Oil Gas J.*, 14.7.38, **37** (9), 34.—The importance of well studies made with the aid of a polished rod dynamometer is being realized, and many companies have departments the sole duty of which is to study pumping well problems. This work enables a better selection of the proper sucker rod to meet the conditions in each individual well, and a better knowledge of each individual well's characteristics enables the producer to obtain a longer life out of his equipment.

The main consideration of this type of work has been the load characteristics of individual wells and their effects on sucker rods. The popular instrument used for this operation is the electrical strain-gauge type of dynamometer in which the load is measured by the amount of compression in the strain gauge placed between the hangar bar and the polished rod clamp.

Office records of each well should be studied in order to get the most out of a dynamometer study. L. V. W. C.

1280. Pumping and Sand Problems of the Wilmington Field. T. P. Sanders. *Oil Gas J.*, 21.7.38, **37** (10), 34.—Drilling problems in the Wilmington field of California have caused little trouble, but operators expect difficulties from producing conditions. Butane powered rigs have been used for Wilmington drilling, and their use has been very successful, due to the smaller space requirements. Cementing of casing is accompanied by no serious problems, and mechanical mixers are used. The average weight of slurry used is 113 lb. per cubic foot.

Multiple zone producing is one of the most unusual features developed in this field. The greatest advantage of this method of producing is its selective production feature. The zone yielding the highest-gravity oil may be produced to furnish the well's entire allotment, whilst production from the other zones is available when needed.

Gravel packing of production liners is another practice which has become popular.

Sand troubles can be avoided to some extent by the prevention of excessive production rates during the early flowing period. The velocity of flow succeeds in starting an excessive movement of sand, and greater difficulty is experienced in reducing sand production by cutting back the rate of flow. The removal of a small portion of the sand body makes the dislodging of adjacent portions easier.

Sand makes the pumping of most Wilmington wells difficult and expensive; the wear on sucker-rod couplings is especially severe. In some cases a coating of synthetic rubber on each coupling is used to avoid wear, and this practice is proving successful. Rod rotators have recently come into use. These are surface devices installed between polished rod and rod hangar, and the rods are turned a fraction of a revolution at the bottom of each downstroke by means of a ratchet handle.

Mud levels in the wells are taken by either the pressure wave- or sound-wave method of fluid-level determination. When the products from a well falls noticeably, a fluid test is the quickest way to determine the cause. L. V. W. C.

1281. Chemical Phases of Treating Water for Flooding Oil Properties. B. O'Connor. *Oil Gas J.*, 4.8.38, **37** (12), 43.—Water treatment to prevent plugging of oil and gas producing formations in the operation of water-flooding projects is considered, particularly with reference to supersaturation and algae. The subject is dealt with fully.
L. V. W. C.

1282. Retarding Acidizing Solution and its Application in Oil Fields. P. Menual. *Oil Gas J.*, 4.8.38, **37** (12), 54.—In acidizing oil or gas wells, the reaction takes place deep within the earth, where pressure is an important factor. Pressure is built up by the reaction of acid on limestone, and the rate of reaction will be found slowest at the maximum pressure. The hydrostatic pressure of the acid in tubing, exclusive of pump pressure, is 465 lb. for each 1000 ft. of depth. An apparatus has been developed which permits the rate at which the acid is neutralized by the formation to be studied.

When the acidizing solution reacts with the formation under quiescent conditions, which is the condition under pressure, the rate of reaction on both limestones and

dolomites should be nearly the same. The rate of reaction on limestones will be considerably retarded, whilst a lesser effect will be found in the case of dolomites.

The rate of reaction being of importance, it is possible to consider whether to retard the rate of reaction when acidizing fast-reacting limestone or to accelerate the rate of reaction in the case of slow-reacting dolomites.

Retardation may be accomplished by adding to acidizing solutions a very weak acid which will also form soluble lime salts, such as acetic and lactic acids, or by adding a soluble salt which will repress the activity of HCl, or by adding a chemical which will form a more insoluble coating on the surface of the formation.

Klersol chemicals, when added to 15% HCl and allowed to react under pressure on limestones or dolomites, definitely retard the rate of reaction. In addition, the spent acid is clear even when allowed to react to completion. L. V. W. C.

1283. West Texas Drilling-In Practices are being Closely Studied. M. Tucker. *Oil Gas J.*, 23.8.38, **37** (6), 44.—The present study of the drilling-in problem in the W. Texas and New Mexico areas is one of technique of completing the wells. Some of the most important objectives of correct well completion in this territory may be summarized as follows :

1. A clean formation face must be preserved, a proper size hole must be drilled, and shooting and acidizing must be carried out to afford the highest official potential test possible.
2. Gas–oil ratios should be as low as possible.
3. The thick pay selection should be drilled and logged in the most careful manner possible.
4. The pay section should be drilled, and the well placed on production in the shortest possible time and at the minimum expense.

Pressure drilling is done with oil as a circulating fluid in the low-pressure fields, although in some isolated instances gas or gas and oil have been used.

The reverse circulation or Beckman process is finding an application on both wild cat and field wells. L. V. W. C.

1284. Valve System Designed to Aid Production from Different Zones in Small Gas Wells. E. Orr. *Petrol. Engr*, Sept. 1938, **9** (13), 25.—The life of many gas wells in the W. Virginian properties, which are constantly threatened by the sub-surface encroachment of oil and water, can be extended and the gas production increased by the proper control of this encroachment. A valve system has been invented and installed in several wells of doubtful economic value. The system consists of valves of two types : the shield type and the mandrel or ball type.

When the system is installed in a well, the mandrel or ball valve is placed on the bottom of the tubing, and the shield valves are placed at various points opposite each producing sand between the tubing and perforated casing.

The shield-type valves allow any liquid in the gas to enter the tubing when it can be swabbed or blown from the well.

The mandrel valve operates the entire system. It opens automatically when the pressure in the sand builds up. L. V. W. C.

1285. Mechanical Sampling and Continuous Water Removal Aid Gauging Field Tanks. B. Mills. *Oil Wkly*, 15.8.38, **90** (10), 32.—The cost of field gauging tanks has been lowered by the installation of a reliable mechanical sample device in conjunction with a system of continual water removal.

Two tanks are set up, and production is led into the first, which is equipped with a syphon-water outlet that allows water to be drained continually from the tank bottom. A horizontal connection to the adjacent tank is made approximately at the mid-point of the tanks, and this permits clear crude to be skimmed from the top and gauged. Total production, water production and oil production can be determined without holding total production for future separation. L. V. W. C.

1286. Sour Gas and High Gas/Oil Ratio Problems Overcome at Otis. F. B. Taylor. *Oil Wkly*, 15.8.38, **90** (10), 42.—The major operating problems in the Otis field have been high gas/oil ratios and gas production averaging high in sulphur content.

Desulphurizing plants have been constructed, and in addition to reducing the sulphur content to near absolute zero, each plant dehydrates the gas, both operations being accomplished with the same fluid mix.

The problem of reducing gas/oil ratio is overcome by the use of packers of various types. To prevent an over-reduction of pressure above the packer, oil is pumped between the tubing and casing to add pressure and resistance against any coning tendency. L. V. W. C.

1287. Elimination of Counterweight Vibration Lengthens Rod Life. M. T. Pate. *Oil Wkly*, 25.7.38, **90** (7), 47.—The average well in the E. Texas field not exceeding 3000 ft. in depth, and reasonably vertical, has not presented any serious rod troubles, but there have been exceptions. Many breakages have occurred which could not be blamed on paraffin accumulations.

Investigations have shown that in one instance a sudden stress has been applied which could not be explained by any variation in the pumping load. It was found that the over-load came only at certain pumping speeds, and then only after the well had been pumped steadily at that speed from 15 to 30 min.

Observation showed that at certain speeds the counterweight tended to bind on the guide-pipe, momentarily arresting the descent of the weight. This threw the entire rod weight against the rod-line in addition to the normal pumping load. Revision of the counter-balance system completely suppressed the pendulum action of the suspended counterweight, and the trouble was overcome. L. V. W. C.

1288. Oil-Well Performance. B. P. Kantzer and E. G. Trostel. *Oil Wkly*, 25.7.38, **90** (7), 48.—The study of well performance has resulted in a number of general terms of indefinite meaning having been evolved. This paper has limited these terms by introducing specific definitions. New terms have been included to describe adequately the general subject of oil-well performance. L. V. W. C.

1289. Technological Aspects of Water-Flood Curtailment. S. T. Yuster. *Oil Wkly*, 29.8.38, **90** (12), 30.—Research study in the Bradford district indicates that no appreciable quantity of oil need be lost because of the restriction of production from properties under water-flood.

Six curtailment methods are practiced, and each results in a decrease in the fluid throughput on a property. Each method is considered in some detail, and the calculations to determine the extent of the reduction in input and, therefore, the curtailment in production, are given. L. V. W. C.

1290. Methods of Oil Extraction Used in the Polish Fields. S. Bielski. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 977–981.—In non-flowing wells, the oil was produced by pumping, bailing and swabbing. These methods are still used extensively in some fields, the bailing being applied to wells which would otherwise have been abandoned. 86% of the Boryslaw production is obtained by swabbing, although such a method is known to be harmful to the reservoir, and wastes gas. Repressuring with gas or air, and gas- and air-lift have been applied successfully in some areas. Swabbing costs range 118 to 386 zlotys per cistern (10 tonnes) and pumping 118·5 to 380 zlotys. The maximum figures are more common for the former method, and the minimum figures for the latter. Air- or gas-lift costs 50–182 zlotys per cistern.

Group pumping is the common practice.

Due to lack of capital and a reluctance to risk new methods, the production practice is only slowly taking advantage of new developments. However, the decline in production was arrested in 1936 without the discovery of new fields, which points to the value of the application of modern production methods. G. D. H.

1291. Recovery of Oil Under Water Drive Conditions. W. Tempelaar Lietz. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 983–988.—A mathematical analysis is made of the flow of oil, followed by water, through two capillary tubes of different diameters and connected at each end. It has been found that the movements of fluids in reservoir rocks tend to follow Darcy's law and the conclusions arrived at in the above

analysis may therefore be applied to the study of the recovery of oil from reservoirs under conditions of strong water drive. The recovery of oil under such conditions depends on the physical properties of the fluids and the rate of advancement of the edgewater. Highest recovery is to be expected from reservoirs having pore spaces of uniform dimensions. Although under ideal conditions 100% recovery should be obtained it would be uneconomic to produce the whole of the oil in the smaller pore spaces on account of the high water-oil ratio involved. S. E. C.

1292. Intermittent Flowing Production as a New Means for Reducing G.O.R. G. R. Zmieuranu. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 989–999.—The reservoir conditions around a flowing well are discussed and the formation of the gas cone is demonstrated. On closing down a well, static conditions tend to be re-established immediately, and the gas cone disappears. The method proposed takes advantage of this fact, and consists in opening and closing a well at fixed intervals by means of an electromagnetic valve controlled by a timing device. By thus controlling the depth of the gas cone, the amount of gas produced with the oil is controlled. Some figures taken from tests of the method in Roumania are given. S. E. C.

1293. Modern Pumping Practices. J. J. Donnelly. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 1001–1003.—Many improvements have been made in the past few years in sucker-rod installations. Amongst these are the introduction of the portable winch, back cranking and the application of slow motion to small producers.

Various oil-raising methods which do not employ sucker-rods have been introduced for very deep wells. The Kobe hydraulic pump, Hughes plunger lift and the Reda multistage centrifugal pump are of special interest in this connection.

G. D. H.

1294. Automatic Pumping at Pechelbronn. M. R. Decker. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 1005–1007.—Pumping is the only method of oil extraction used at Pechelbronn. There are 600 installations, each with its own electric motor. Wells have daily outputs of oil and water ranging from 50 to 15,000 litres. Hence in most cases the pumping is intermittent.

Formerly the periods of pumping were controlled by hand, and later the installation of remote control was considered. A few wells were fitted with clock-actuated devices, but these were costly, and required much attention. Some semi-automatic controls are in use, but a fully automatic device is now employed, which is actuated by two annular floats. The pump is started when the liquid reaches a certain level, and stopped when it has fallen to a fixed lower level. G. D. H.

1295. Multistage Separation of Crude Oil and Gas. C. J. May. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 1009–1015.—Multistage separation of gas from high-pressure wells has several advantages, such as the reduction of load on the gasoline recovery plant, the low loss of butanes, etc., and there being no need to compress the intermediate fractions for the recovery plant. In the present paper the general conditions for obtaining the maximum separation between two low-boiling-point components are calculated, and a practical method is given for the determination of separator pressures, together with equations for the relative efficiencies of various numbers of stages. S. E. C.

1296. Production Patents. V. York. U.S.P. 2,127,900, 23.8.38. Tubing catcher.

S. A. Mullins. U.S.P. 2,128,212, 23.8.38. Sample-taking tool for oil wells.

A. E. Johnson. U.S.P. 2,128,253, 30.8.38. Well-testing tool comprising a chamber for a first fluid with a movable valve structure and a sealing means and communication with the well formation, so that pressure of a second fluid may be exerted on the valve. The first fluid is locked in the chamber, so restraining the valve from movement. Means for bleeding the locked fluid from the chamber due to a differential pressure on the valve, and means for permitting well fluid to enter after discharge of a predetermined amount of the hydraulic fluid.

E. A. Rodgers. U.S.P. 2,128,475, 30.8.38. A flow-controlling device for oil wells.

N. H. Armstrong. U.S.P. 2,128,520, 30.8.38. Tubing drain.

C. R. Phillips. U.S.P. 2,128,593, 30.8.38. Tubing and casing stripper.

J. N. Smith. U.S.P. 2,128,716, 30.8.38. Well-testing device.

J. E. Hoover, U.S.P. 2,129,090, 6.9.38. Intermittent gas-lift pump.

J. E. McLagen. U.S.P. 2,129,531, 6.9.38. Tubing blow-out preventer.

F. C. Kniss. U.S.P. 2,130,138, 13.9.38. Perforating gun for oil wells.

M. A. Cowen. U.S.P. 2,130,267, 13.9.38. A paraffin scraper having an inwardly tapered portion, a cup-shaped carrier located at the tapered portion and movable sector-shaped blades about this portion and reversely tapered for seating and unseating in and from the carrier.

A. J. Penick and K. T. Penick. U.S.P. 2,130,578, 20.9.38. Deep well pump.

C. S. Crickmer. U.S.P. 2,131,274, 27.9.38. A well packer having a fluid passage through it and means for closing the passage when the packing element is set.

C. S. Crickmer. U.S.P. 2,131,275, 27.9.38. Slip mounting.

T. Seifer. U.S.P. 2,131,392, 27.9.38. Hydraulic motor operated by means of a flushing fluid in a well. L. V. W. C.

See also Abstract No. 1212.

Transport and Storage.

1297. Modern Bulk Plants Conserve Light Fractions of Motor Fuel. H. S. Norman. *Oil Gas J.*, 18.8.38, **37** (14), 60.—By storing motor fuel in pressure tanks or in systems where vented vapours are retained in a balloon tank and later condensed for return to the source, retention of the more volatile hydrocarbons in the stored motor fuel is achieved, and a saving conservatively estimated at 6 galls. per annum per sq. ft. of exposed gasoline surface is effected as compared with storage in conventional systems unqualified to withstand much more than atmospheric pressure from within.

Adoption of spheroid tanks for new storage, where practical, and of balloon tanks to operate in conjunction with existing cylindrical vessels which are still serviceable, has been practiced extensively by the Standard Oil Co. of New Jersey. The company has thirty-one pressure tanks in service storing finished motor fuel and thirteen under construction or scheduled. Cost of the new spheroid varies from 30% to over 75% more than that of conventional tanks, but this is offset by the saving in motor fuel. Typical charts utilized in balloon tank and pressure-tank installations are presented to show calculated vapour savings, effect of atmospheric temperature on vaporization, effect of variations in quantities of withdrawals, etc. Stored in pressure tanks in locations isolated for 6 months during the year by ice, motor fuel has been found to remain unchanged in quality over a period of months. R. A. E.

Crude Petroleum.

1298. Assays of Crudes Produced in Rumania Between 1936 and 1938, and the Properties of the Products. E. Casimir. *Monit. Pétr. roum.*, 1938, **39**, 1217–1233.—Assays of 131 crudes, produced in the last two years, are tabulated and the results reviewed. Gasoline content varies between 0·7% in Sarata Monteoru and 83% in Margineni, kerosine ranges from 7·7% in Margineni to 39·5% in Arbanasi, gas oil from 0·0% in Margineni to 18% in Sarata Monteoru, and fuel oil 0·0% in Haimanale and Margineni to 73% in Tintea.

The gas oil receives particular attention. Twenty-four gas oils are classified according to their paraffinic content and the sp. gr. pour point, and diesel index of each

recorded. Thus, the least paraffinic gas oil is obtained from Moreni, it has a sp. gr. of 0·880, pour point below — 20° C., and a diesel index of 31·1. The most paraffinic gas oil comes from Bucsani, with a sp. gr. of 0·822, pour point +5° C., and diesel index 75. T. C. G. T.

1299. New Method of De-watering Crude Oil. H. and W. Passler. *II^me Congrès Mond. Pétrole*, 1937, **1** (Sect. 1), 1019–1021.—The encroachment of edge-water in the well Gosting 2 (Zistersdorf, Austria) has resulted in the formation of very stable and thick emulsions with the heavy crude. A special type of apparatus was designed to break down this emulsion. It is passed in a slow stream through a high-voltage (12,000-v.) alternating field produced between rows of electrodes of special form. The apparatus handles 80–100 cu. m. of emulsion per day, with a power concumption of 15 kilowatts. S. E. C.

1300. Patents on Crude Oil. I. M. Colbeth. U.S.P. 2,126,368, 9.8.38. Mineral-oil emulsions are broken using liquid castor oil which has been bleached by oxidation at 320° F. and oxidized by air-blowing at 285° F.

J. G. Suthard. U.S.P. 2,126,839, 16.8.38. Mineral-oil emulsions are broken by means of a sodium soap of a sulphonated hydrocarbon polymer.

H. J. Robertson. U.S.P. 2,127,140, 16.8.38. Demulsification of cut oils using a demulsifying agent consisting of a water-soluble soap, a fatty material, *cyclo*hexanol and furfural potassium hydrogen sulphite.

H. J. Robertson. U.S.P. 2,127,141, 16.8.38. Demulsifying cut oils using a water-softening agent and the reaction product obtained by the action of ammonia and a compound R.CHO where R represents a hydrocarbon radicle. W. S. E. C.

Gas.

1301. Studies on Rumanian Methane. C. Candea. *Monit. Pétr. roum.*, 1938, **39**, 1139–1145.—Apart from its use as a fuel, CH_4 may be utilized for the preparation of hydrogen, as a reducing agent in metallurgy, and in the preparation of HCl. The manufacture of H_2 is of considerable importance to the petroleum industry, and the author's work on the hydrogenation of petroleum is summarised.

The researches carried out in order to obtain pure H_2 by the thermal decomposition of CH_4 are described. Without catalysts, even at 900–1000° C., there is only a 9·3% yield of H_2, and 77·4% of CH_4 is unchanged. Complete decomposition is obtained at 800–1000° C. in the presence of catalysts, particularly those of Ni, and with gas speeds of 3·5 l. per hr. The decomposition is merely $CH_4 = C + 2H_2$, and the carbon is very finely divided and activated.

The reaction of CH_4 with steam has also been investigated, and it is found that at 1000° C. with a contact time of 20 secs. a 1 : 3 mixture of CH_4 and H_2O will produce 70% H_2 and 20% CO, the catalyst being Fe, Ni, and Mn oxides on Fe turnings.

Experiments have also been carried out on the use of methane for the reduction of the minerals hematite and limonite and of the oxides of Fe, Sn, Zn and Cu. The ideal conditions in the reduction of 1 g. of Fe_2O_3 were 2–2·5 l. CH_4 per hr. at 900° C. Above this temperature formation of C occurs. ZnO is completely reduced at 900° C., CuO at 720° C. and SnO_2 at 910° C.

CH_4 may be reacted at 800–1000° C. with the chlorides of Ca, Na, Li and K, to give HCl according to the equation $CH_4 + 2NaCl = 2NaH + 2HCl$. This reaction is preceded by $CH_4 \rightarrow C + 2H_2$. T. C. G. T.

1302. Gas Purification by the I.G. Alkacid Process and Sulphur Recovery by the I.G. Claus Process. H. Baehr. *Refiner*, June 1938, **17** (6), 237.—The use of alkaline inorganic scrubbing agents, such as Na_2CO_3 or K_2CO_3, for the removal of H_2S and CO_2 from gases is not always economical, owing to the low absorptive capacities of those reagents. Much greater absorption efficiency is shown by solutions of K_3PO_4 and the slightly volatile organic bases of the alkylolamine group such as mono-, di-, and tri-

ethanolamine. These reagents are used in the Girdler process. In the alkacid process strong inorganic bases with weak organic non-volatile organic acids, such as aminosulpho acids and aminocarbonic acids, are used as the absorption reagents. Three solutions are available commercially—namely, Alkacid solution "M," "Dik," and "S." Alkacid "M" is used for the removal of H_2S and CO_2, either separately or simultaneously. Alkacid "Dik" removes H_2S selectively from gases containing H_2S and CO_2, and Alkacid "S" is used for the removal of H_2S and CO_2 from gases containing other impurities in the form of tar, dust, etc. The selectivity of Alkacid solutions depends on the plant conditions as well as their chemical composition. Absorption is carried out at approximately 20° C., and the solutions are regenerated by heating to 105° C. In the Claus process for the recovery of S from the H_2S, part of the H_2S is burnt in the presence of a catalyst to SO_2, which is then passed with the rest of the H_2S through a contact tower for the recovery of S.

$$H_2S + 1\tfrac{1}{2}O \longrightarrow SO_2 + H_2O + 124 - 138 \text{ kg.-cal. in the boiler}$$
$$H_2S + SO_2 \longrightarrow 2S + H_2O + 21 - 35 \text{ kg.-cal. in the catalyst.}$$

The heat of reaction in the first stage is recovered in a steam boiler. H. G.

1303. Patents on Gas. G. W. Johnson. E.P. 487,673, 23.6.38. Apparatus for removal of H_2S from hydrocarbon liquids—*e.g.*, from benzene using the sodium salt of alanine.

F. W. Haywood., C. H. Bosanquet, J. L. Pearson and I.C.I., Ltd. E.P. 491,154, 26.8.38. Apparatus for determining small quantities of gases and vapours in gaseous mixtures.

G. W. Johnson. E.P. 491,568, 5.9.38. Manufacture of acetylene by the oxidation of methane. W. S. E. C.

Cracking.

1304. The Production of Fischer–Tropsch Coal Spirit and its Improvement by Cracking. C. S. Snodgrass and M. Perrin. *J. Instn Petrol. Tech.*, 1938, **24**, 289–301.—A description of the Fischer–Tropsch process and the results obtained by cracking the resultant products by the True Vapour-Phase process. D. L.S.

1305. Patents on Cracking. Houdry Process Corpn. E.P. 487,785, 23.6.38. Apparatus for the catalytic treatment of hydrocarbons and regeneration of the catalyst.

P. A. Maschwitz. U.S.P. 2,125,734, 2.8.38. Production of high-octane gasoline by simultaneously distilling crude oil, cracking the heavy oil, reforming the naphtha and polymerizing the hydrocarbon gases in a single furnace structure.

W. S. Gullette. U.S.P. 2,127,815, 23.8.38. Improved oil heater for cracking furnaces. W. S. E. C.

Hydrogenation.

1306. Patents on Hydrogenation. International Hydrogenation Patents Co., Ltd. and I. G. Farbenindustrie A.-G. E.P. 487,892, 28.6.38. Destructive hydrogenation of carbonaceous substances using as catalyst, preformed zinc formate or acetate, together with halogen compounds of carbon or sulphur.

H. E. Potts. E.P. 488,513, 8.7.38. Hydrogenation of brown coal and extraneous pasting oil in which recycled fractions are first mixed with the initial material to precipitate asphaltic substances. Asphalt free oils, especially diesel oil and benzine, are produced.

H. Dreyfus. E.P. 488,609, 6.7.38. Hydrogenation of products obtained by the solvent extraction of coal using a nickel catalyst at 200–400° C. and above 10 atm. pressure, to produce organic compounds. The sulphur in the coal products is removed by washing with an aqueous alcoholic or alcoholic solution of caustic soda.

G. W. Johnson. E.P. 488,651, 7.7.38. Catalytic hydrogenation of carbonaceous substances to produce motor fuel. The catalyst consists of one or more metals —*e.g.*, Mn, Fe, Cu, Zn—in the form of preformed sulphides or phosphates and a compound consisting of one or more of the following metals: Mo, Sn, Rh, W, Ur, V, Cr, Ni, or Co.

H. E. Potts. E.P. 488,856, 11.7.38. Hydrogenation of carbonaceous substances made into a paste with oil using as catalyst sulphides of the fifth, sixth, or iron group, of the periodic system formed into pieces and stationarily contained in the reaction space below 415° C.

Oil Processes, Ltd. E.P. 489,544, 25.7.38. Desulphurizing and sweetening light hydrocarbon oils by hydrogenation in vapour form at 500–900° F. in the presence of added steam without cracking in the presence of metallic Ni, Co, Cu or Fe as catalyst and alumina, chromium oxide, thoria or magnesia as promoters.

H. E. Potts. E.P. 490,768, 22.8.38. Hydrogenation of polymerization products of unsaturated aliphatic hydrocarbons in at least two stages—firstly, partial hydrogenation (hydrofining), and secondly, completing the hydrogenation in a converter or plurality of converts using a nickel catalyst.

S.C. Fulton. U.S.P. 2,125,714, 2.8.38. Production of motor spirit of improved volatility and octane number by subjecting a heavy naphtha fraction of low volatility and low octane number to a non-catalytic pressure refining and dehydrogenating the refined naphtha.

R. Rosen. U.S.P. 2,126,817, 16.8.38. Conversion of isobutane into liquid polymers of gasoline range by passing a mixture of *iso*butane and SO_2 over a dehydrogenating catalyst and contacting the resultant products with a catalyst to polymerize *iso*butylene to form liquid polymers.

M. Pier, P. Jacob and W. Simon. U.S.P. 2,127,381,–2,127,383, 16.8.38. Destructive hydrogenation of hydrocarbon products at 200–700° C., using as catalyst tungsten or molybdenum sulphides.

K. Winkler. U.S.P. 2,127,577, 23.8.38. Destructive hydrogenation of solid carbonaceous substances at 380–550° C. and under 50 atm. pressure to produce hydrocarbons of low mol. wt. W. S. E. C.

Polymerization.

1307. Polymerization. R. E. Burk. *Industr. Engng Chem.*, 1938, **30** (9), 1054.—An attempt is made to draw some generalizations about the mechanism of polymerization, more particularly with reference to hydrocarbon polymerization. Various generalizations may be drawn concerning the relation between molecular structure and the tendency of molecules to polymerize; such generalizations should not, however, be too rigid. The reason for this is that most polymerization reactions, especially those in the liquid-phase, are strongly influenced by catalysts such as oxygen, and the products of oxidation of unsaturated compounds.

The precise mechanisms for the action of catalysts in general have not been elucidated, although in some cases, such as the action of sodium on 1 : 3-butadiene, definite intermediate compounds are plausible. One idea is that in addition polymerizations the growing polymer is a free radicle, but so far theorists have not agreed as to the details of the theory. This free-radicle theory appears plausible when the catalyst is a decomposing organometallic compound.

A second theory suggests that catalysts are essential to polymerization reactions, and that the catalyst remains associated with the growing polymers, which need not be a free radicle. In some instances this mechanism has been reasonably well established, but should not be accepted as a general explanation of such phenomena.

The structure of polymers may give some indication upon the mechanism of their formation, but so far such information is too meagre to carry much weight.

This review thus gives a short résumé on the current thought concerning the mechanism of polymerization reactions. H. E. T.

1308. Patents on Polymerization. G. W. Johnson. E.P. 490,366, 10.8.38. Production of polymerization products similar to rubber from butadiene or its substitution products in the presence of solid highly polymerized *iso*butylene with sodium or peroxides as catalysts.

Universal Oil Products Co., E.P. 490,854. 23.8.38. Catalytic polymerization of olefines (4C atoms), using solid pyrophosphoric acid catalyst together, with a small quantity of kieselguhr—*e.g.*, of normal and *iso*butylenes to form *iso*-octane polymers which are then hydrogenated to form *iso*-octane.

G. L. Hugel. E.P. 491,850, 9.9.38. Production of synthetic oils to incorporate with lubricating oils by first depolymerizing rubber or highly polymerized unsaturated hydrocarbons in the presence of activated carbon. The mineral substances and non-combined sulphur are removed at high temperatures and pressures in the presence of caustic alkali. The product is then hydrogenated in the presence of a catalyst.

A. Carpmael. E.P. 491,932, 12.9.38. Polymerization of mono-olefines in the presence of a mixture of ortho and metaphosphoric acids (sp. gr. 1·90–1·99 at 15° C.).

S. C. Fulton and T. Cross. U.S.P. 2,126,001, 9.8.38. Production of valuable polymers by passing a mixture of 20–40% of normal butenes and 10–15% of *iso*butylene over a catalyst at 200–350° C. under normal pressures. The polymer is separated from the cooled reaction product and the residual mixture is passed over a second catalyst at 50–150° C. to condense the remaining olefines. The polymer is separated from the residual gas.

A. E. Dunstan and Anglo-Iranian Oil Co., Ltd. U.S.P. 2,128,126, 23.8.38. Polymerization of propylene and butylenes to produce motor spirit, using a catalyst prepared by mixing ortho-phosphoric acid and cadmium and copper *ortho*-phosphates in molecular proportions 3 : 1 : 1–8 : 1 : 1, and heating and drying the mixed mass at 100° C.

T. Cross Jr., and S. C. Fulton. U.S.P. 2,129,649 and 2,129,732, 13.9.38. Polymerizing gaseous olefines to form high boiling polymers using as catalyst 5–3% of Zn or Cd oxides, a minor proportion of alumina and a major proportion of silica gel. The reaction is carried out at 200–400° C. and under pressures over 100 lb. sq. in.

S. C. Fulton and T. Cross, Jr., U.S.P. 2,129,733, 13.9.38. Polymerization of gaseous olefines as described in U.S.P. 2,129,649, using as catalyst oxides of lanthanum, indium or thallium. W. S. E. C.

1309. Patents on Pyrolysis. Universal Oil Products Co. E.P. 490,853, 23.8.38. Catalytic pyrolysis of hydrocarbons to produce low-boiling motor fuel. The catalyst is prepared by partly or completely replacing the alkali metals originally contained in zeolite by one or more of the following: Ca, Mg, Sr, Ba, Zn, Al, Mn, Fe, Ni, Co. The process is carried out at 425–540° C. and at atmospheric or super-atmospheric pressures. W. S. E. C.

Refining and Refinery Plant.

1310. Nickel-bearing Alloys used in Petroleum Refining. B. B. Morton. *Refiner*, June 1938, **17** (6), 306.—Nickel-bearing alloys are meeting ever-widening demands in petroleum refining. 2·25% Ni steels are being employed on dewaxing plants at relatively low temperatures. Monel, Inconel and the 18/8 alloys are available for conditions of extremely low temperature and where the corrosion hazard is great. Even at a temperature as low as − 150° F., 2·9% Ni steels are shown to possess quite remarkable strength. In the middle ranges of temperature Cu/Ni alloys are doing good service as condensers and heat exchangers. Ni-resist, an austenitic cast iron, finds wide application in the manufacture of bubble caps, acid pumps and other units where high corrosion resistance is demanded. Ni/Cr alloys find their principal applications in high-temperature service, particularly where corrosive S is present. At

temperatures above 1400° F. 25% Cr/20% Ni and 28% Cr/12% Ni alloys are the most popular. Similar alloys with an addition of molybdenum exhibit good resistance to mineral and organic acids and to the phenols. H. G.

1311. Steam Condensation: Effect of Tube Position. H. J. Quigg, W. C. Moyer, and R. L. Huntington. *Industr. Engng Chem.*, 1938, **30** (9), 1047.—A single-tube condenser, 4 ft. 9 ins. long, 0·84 in. o.d., was set up with water passing through the tube and steam passing outside. The tube was surrounded by a Pyrex jacket. The tube was set up horizontal, vertical and at 45° for the various runs.

Overall coefficients of heat transfer were unaffected by tube position at low values of the Reynold number, but at higher values the 45° and horizontal tubes showed coefficients respectively 25 and 50% higher than for the vertical tube.

The individual film coefficients were obtained by graphical analysis.

About one-fifth of the area was covered with dropwise condensation in the case of the horizontal tube, and one-tenth in the vertical tube. Film thicknesses on the steam side were measured and compared with those calculated from the Nusselt equation. The measured thicknesses were considerably larger, which is attributed to the presence of ripples. P. D.

1312. Multipass Exchanger Calculations. H. Ten Broeck. *Industr. Engng Chem.* 1938, **30** (9), 1041.—The equations of Underwood, Nagle and Fischer for multipass exchangers are complicated and necessitated trial-and-error calculations in those cases where the terminal temperatures are to be calculated.

The equations are rearranged and plots presented for 1 : 2 and 2 : 4 exchangers which avoid this inconvenience. P. D.

1313. Log Mean Difference. T. N. Dalton. *Industr. Engng Chem.*, 1938, **30** (9), 1081.—The log mean difference between two values may be rapidly calculated on a slide rule provided with log. log. scales. The process involves only two settings of the rule, and may be summarized as follows, where Δ_1 and Δ_2 are the two values whose mean is to be obtained ($\Delta_1 > \Delta_2$).

(1) Subtract Δ_2 from Δ_1, giving $(\Delta_1 - \Delta_2)$

(2) Divide Δ_1 by Δ_2 giving Δ_1/Δ_2

(3) Opposite Δ_1/Δ_2 on the log. log. scale place $(\Delta_1 - \Delta_2)$ on the C scale and read the answer on the C scale against the index of the D scale. P. D.

Chemistry and Physics of Petroleum.

1314. Specific Heats of Organic Vapours. P. Fugassi and C. E. Rudy. *Industr. Engng Chem.*, 1938, **30** (9), 1029.—The specific heat of an organic vapour can be calculated from a knowledge of the chemical bonds present in the compound by means of equations given in this paper. As an example the specific heat of benzene vapour is calculated at 1 atm. and at temperatures up to 350° C. The calculated figures agree with experimental figures to within 2%. Paraffin hydrocarbons, esters and alcohols give equally good agreement. P. D.

1315. Separation Processes. General Methods of Analysis. M. Randall and B. Longtin. *Industr. Engng Chem.*, 1938, **30** (9), 1063.—Graphical methods of representing additive quantities, such as total heat when plotted against concentration, are described and applied to a fractionating column considered in sections : rectifying column, stripping column, feed and withdrawal units. The method is applicable to any other counter-current process; for example solvent extraction, in which it is permissible to consider two components only. P. D.

1316. Energy Content of High-Pressure Gases. E. W. Geyer. *Engineer*, 1938, CLXVI (4312), 256.—Expressions are deduced for the available energy of compressed gases from thermodynamic considerations. Two cases are examined, one without and the other with heat-flow into the charge.

Typical examples are worked out, and tables are given showing the available energies for various pressures. J. G. W.

1317. Separation of *iso*Propylbenzene from a Midcontinent Petroleum by Adsorption with Silica Gel and Distillation with Acetic Acid. J. D. White and F. W. Rose, Jr. *Bur. Stand. J. Res.* (*Wash.*), 1938, **21**, 151–165.—*iso*Propylbenzene was one of the first compounds to be found in petroleum.

In this investigation a fraction from an Oklahoma crude b. p. 144–154° C. was first treated to remove *n*-nonane and xylenes. The fraction remaining after these extractions contained about 3% volume of *iso*propylbenzene.

The aromatic constituents of this cut were removed by adsorption with silica gel, followed by separation of the adsorbed oil by distillation with acetic acid. This was followed by a further filtration through silica gel to remove moisture, acetic acid and condensation products, and the product was finally distilled through a 2·5 m. chain packed column.

The hydrocarbon obtained had the following properties: b.p.$_{760}$ 152·39° C.; f.p. −96·46° C.; d_4^{20} 0·8634; n_D^{20} 1·4914; mole.-% purity 98·4.

A synthetic product of calculated purity 99·8 mole.-% compared as follows: b.p.$_{760}$ 152·38° C.; f.p. −96·25° C.; d_4^{20} 0·8633; n_D^{20} 1·4915.

It was estimated that the original crude contained approximately 0·03% *iso*propylbenzene. D. L. S.

1318. Separation, by Distillation with Acetic Acid, of the Aromatic Hydrocarbons from the Fraction of a Midcontinent Petroleum boiling between 154° C. and 162° C. F. W. Rose, Jr., and J. D. White. *Bur. Stand. J. Res.* (*Wash.*), 1938, **21**, 167–184.—The methods which have been previously used to separate aromatic hydrocarbons as a class are reviewed, and a recent azeotropic method involving distillation with acetic acid is described.

A synthetic system consisting of 90% *n*-nonane and 10% synthetic *iso*propylbenzene was investigated. On distilling with acetic acid, about 85% *n*-nonane free from aromatics was recovered. Another mixture containing 20% of the aromatic constituent gave relatively the same percentage recovery of *n*-nonane.

A fraction from an Oklahoma crude b.p. 154° approx. was separated in this manner into a mixture of paraffins and naphthenes and complete separation of the aromatic constituents. The aromatic fraction still contained a trace of the paraffin–naphthene mixture, and was purified by further distillation with acetic acid.

The method was then applied to a cut from the same crude, b.p. 154–162° C., and the first distillate divided into: (*a*) paraffin–naphthene mixture, (*b*) intermediate fraction, (*c*) aromatic concentrate.

Traces of aromatics were removed from fraction (*a*) by filtering through silica gel, whilst the aromatic concentrate was purified by redistillation with acetic acid. By further retreatment of fraction (*b*), all but 1% could be allocated to (*a*) or (*c*).

Distillation of fraction (*a*) at 215 mm. pressure showed the presence of paraffinic compounds boiling near 157° C. and naphthenic constituents boiling near 161° C.

The aromatic portion boiled for the most part between 158·5° C. and 164·5° C.; about 5° C. higher than the parent fraction. It appeared to contain *n*-propylbenzene and the methylethylbenzenes, as well as high-boiling trimethylbenzenes. D. L. S.

1319. Catalysts in Hydrocarbon Chemistry. E. K. Rideal. *J. Instn Petrol. Tech.*, 1938, **24**, 221–224.—A discussion of the theory of catalytic processes wherein a radical mechanism is formulated. D. L. S.

1320. Saturated High Octane Fuels without Hydrogenation. The Addition of Olefines to *iso*Paraffins in the Presence of Sulphuric Acid. S. F. Birch, A. E. Dunstan, F. A. Fidler, F. B. Pim and T. Tait. *J. Instn Petrol. Tech.*, 1938, **24**, 303–320.—The application of Ipatiev's method for condensing olefines with aromatics to olefines and *iso*paraffins.

The process is thoroughly investigated and its possibilities are explained. D. L. S.

1321. The Viscosities of Hydrocarbons. Parts IV–VI. E. B. Evans. *J. Instn Petrol. Tech.*, 1938, **24**, 321–337.—The absolute and kinematic viscosities of eighteen *iso*paraffins, twenty-one monocyclic naphthenes, seventeen acyclic olefines and one cyclic olefine have been determined at temperatures of 0° C., 20° C., 50° C., 80° C. and 100° C. D. L. S.

1322. Crystal Twins of Normal $C_{24}H_{50}$ and the Influence of Phase Transitions on their Orientation. E. C. H. Kolvoort. *J. Instn Petrol. Tech.*, 1938, **24**, 338–347.—Twin structure was studied on a preparation of $C_{24}H_{50}$ obtained from a Borneo paraffin wax. The work also included the examination of a synthetic product *n*-$C_{24}H_{50}$. D. L. S.

1323. The Chemistry of Petroleum—Past and Present. J. von Braun. *J. Instn Petrol. Tech.*, 1938, **24**, 393–406.—A review of the development of petroleum chemistry given as a lecture to the Hamburg Regional Group of the German Society for Mineral Oil Research. D. L. S.

1324. Temperature-sensitivity of Viscous Oils. D. J. W. Kreulen. *J. Instn Petrol. Tech.*, 1938, **24**, 441–452.—The influence of " asphaltenes " in rendering an oil temperature-sensitive is discussed. This phenomenon appears to be limited to systems with a high viscosity. D. L. S.

1325. Principles of Solvent Dewaxing. Part III. Equilibria and Computations for Double Solvent Systems. M. Ba. Thi, T. G. Hunter, A. W. Nash. *J. Instn Petrol. Tech.*, 1938, **24**, 453–467.—An alternative method of computation, free from the limitations of the method described in Part II, has been devised for the double-solvent mixture where both solvents are completely miscible with the oil at the dewaxing temperature. D. L. S.

1326. Polymerization of Ethylene with Compounds of Aluminium as Catalyst. F. C. Hall and A. W. Nash. *J. Instn Petrol. Tech.*, 1938, **24**, 471–495.—The effect of metallic aluminium on the catalytic polymerization of ethylene with aluminium chloride is discussed. Organo-metallic ethyl derivatives of aluminium are formed during this reaction. D. L. S.

1327. Fatty Acids from Paraffin. Anon. *Chem. Trade J.*, 19.8.38, **103**, 156.—In the " Angewandte Chemie " of August 13 a full report is given of a paper on the subject of methods now being utilized in Germany for the production of fatty acids from the higher hydrocarbons, presented by G. Weitzel at Bayreuth on June 10. The early researches carried out by the I. G. using mineral paraffin and by the Deutsche Fettsaure Werken using soft paraffins from the Fischer–Tropsch synthesis are summarized, and reasons given for the consolidation of the two groups of interest. According to Dr. Wietzel, the actual oxidation stage can be effected with pure oxygen, with air, or with oxygen carriers such as nitrous gases or nitric acid. In practice air oxidation is used, the operation taking place in the liquid phase at temperatures between 80° C. and 170° C., the volatiles removed by the air current being separated by cooling. The available evidence points to the oxidation products being practically wholly straight-chain products, even when the paraffin utilized contains a considerable percentage of branched hydrocarbons. Fatty acids formed are on the average of shorter chain-length than the original paraffin, and are a mixture of products of varying chain-length, indicating that any one of the CH_2 groups in the molecule may be oxidized. The end CH_2 groups are usually unchanged, being more resistant to oxidation. Oxy-acids of various kinds are also invariably produced. To avoid over-oxidation, the following conditions are observed : (1) cessation of process before all paraffin oxidized ; (2) use of lowest possible temperatures, 80—120° C. proving to be the best range ; (3) application of suitable combinations of catalysts ; (4) treatment of paraffin with as finely divided an air spray as possible. Further manufacturing details are provided. Separation of the fatty acids from other oxidation products and unchanged paraffin is the most difficult stage. It can be effected by

agitation with alkali lye, removing the lower layer which separates after settling, and either extracting with solvent or distilling under carefully controlled conditions. The crude product obtained by either method is decomposed with mineral acid and the fatty acid purified by distillation under vacuum. Much is unsuitable, on account of chain-length or odour, for many purposes. The yield of fatty acids suitable for soap-making varies from 50% to 80% of the crude acids distilled, according to the type of raw material. R. A. E.

1328. Vapour Pressure of Solvents. D. H. Killeffer. *Industr. Engng Chem.*, 1938, **30**, 565.—Two monographs are given showing the relationship between temperature and vapour pressure over the range 1–1000 mm. pressure for thirty-three solvents of b. pt. 150–200° C., and for thirty-one solvents of b. pt. above 200° C. J. W. H.

1329. Dehydropolymerization of Ethylene. V. I. Komarewsky and N. Balai. *Industr. Engng Chem.*, 1938, **30** (9), 1051.—By subjecting ethylene to catalytic polymerization in the presence of a polymerizing (phosphoric acid) and dehydrogenating catalyst, a directed conjunct polymerization reaction takes place resulting in increased formation of aromatic hydrocarbons. (Cf. Ipatieff and Pines, *Industr. Engng Chem.*, **27**, 1364). When ethylene is subjected to thermal polymerization in the absence of a polymerizing catalyst, but in the presence of a nickel dehydrogenating catalyst, aromatic hydrocarbons are formed. Both of these reactions are termed "dehydropolymerization" by the authors. These facts prove the correctness of the mechanism of ethylene polymerization suggested by Ipatieff and Pines, who observed that when ethylene was polymerized in the presence of phosphoric acid catalyst, the liquid polymers contained olefinic, paraffinic, naphthenic and aromatic hydrocarbons. These authors explained the formation of these hydrocarbons by the following successive reactions:

1. Polymerization of olefines.
2. Cyclization of olefines to naphthenes.
3. Dehydrogenation of naphthenes to aromatics.
4. Hydrogenation of olefines (formed according to 1) by hydrogen (evolved according to reaction 3), resulting in the formation of paraffin hydrocarbons.

This type of polymerization, where different types of hydrocarbons were formed, was termed "Conjunct polymerization." H. E. T.

1330. Olefine Hydrogenation—Selective Hydrogenation by Nickel Catalyst in the Presence of Aromatics. V. N. Ipatieff and B. B. Corson. *Industr. Engng Chem.*, 1938, **30** (9), 1039.—The selective hydrogenation of olefines in the presence of aromatics has been successfully accomplished both in the liquid phase under superatmospheric pressure and in the vapour phase at ordinary pressure in the presence of nickel catalysts.

In the superatmospheric experiments a batch process was employed, the conditions being contact time 6 hrs., excess hydrogen about 1000%, initial pressure 100 kg.-per sq. cm., and temperature 20–50° C. A rotating 850-c.c. stainless-steel bomb of the Ipatieff type was used, the charge of hydrocarbon being 100 c.c., and catalyst 8 gms., and 100 kg. per. sq. cm. of hydrogen. The liquid recovery averaged 85%. The olefines amylene, di*iso*butene and octadecene were selectively hydrogenated by a nickel catalyst in the presence of the following aromatics: benzene, toluene and xylene, and also of the paraffin *n*-heptane.

In the continuous experiments the liquid charge of olefine plus aromatic was pumped at a constant rate into the upper end of a vertical iron catalyst tube (14 mm I.D.), which held 57 c.c. of catalyst in the form of 8-mesh pellets. At the same time hydrogen was metered into the tube, and the bottom of the tube was connected to an iced condenser for collecting the hydrogenated product. The nickel catalyst employed shows about the same activity as Raney nickel, and has the advantage of cheapness and ease of handling. H. E. T.

1331. Synthesis and Hydrogenation of Poly-Alkylated Benzenes. H. Koch and H. Steinbrink. *Brennst.-Chemie*, 1.8.38, **19** (15), 277–285.—The object of the present

investigations was to examine the relationship between the chemical structure and the properties of lubricating oils. Higher alkyl benzenes were prepared and converted by catalytic hydrogenation into the respective *cyclo*hexane derivatives. From hexaethyl benzene was obtained a mixture of the two stereoisomeric hexaethyl*cyclo*hexanes which is fluid at room temperature, similar in characteristics to spindle oil, with a pour-point of − 46° C.

By the addition of propylene to benzene in the presence of 96% H_2SO_4, tetra*iso*propylbenzene was obtained which on hydrogenation yielded the two tetra*iso*propyl-*cyclo*hexane isomerides. One of these is solid, whilst the other is fluid, with the characteristics of a spindle oil, and a pour-point of − 47° C. The viscosity characteristics of the hydrocarbons produced were investigated.

The conversion of *iso*butene with benzene yielded mainly *p-di-tert.*-butylbenzene, which was hydrogenated to a mixture of the two *p-di-tert.*-butyl*cyclo*hexanes. Both are solid, having pour-points at 95° C. and at about room temperature, respectively. Further experiments were connected with the alkylation of benzene using several other olefines or olefine containing Kogasin fractions in the presence of 96% H_2SO_4.

Benzene has also been converted with *n*-propyl, *n*-butyl, and *n*-amyl chloride, in the presence of Al chloride, and the characteristics of the products of reaction are tabulated. L. R.

1332. Preparation and Chemical Utilization of the Gaseous Hydrocarbons Obtained in the Refining of Coal and in the Synthesis of Liquid Fuels. A. Engelhardt. *Brennst.-Chemie*, 15.8.38, **19** (16), 297–304.—The change over from cellulose materials to mineral coals and petroleum oils as raw materials for the production of aliphatic compounds is discussed, and the conditions of operation are given for the generation of the gaseous hydrocarbons in the processes of high- and low-temperature carbonization, cracking, coal hydrogenation and gasoline synthesis.

Quantitatively and qualitatively, the nature of the gases influences their separation and decomposition by compression, condensation, absorption, adsorption, selective solvent extraction and pressure distillation.

The chemical utilization of mixtures of the gaseous hydrocarbons or separate hydrocarbons is effected by pyrolysis, polymerization, condensation, oxidation, esterification and halogenation. The products thus obtained are either directly used, or are further synthesized, usually by the more recent processes of organic chemistry.

A further increase in the chemical utilization of gaseous hydrocarbons as raw materials is foreseen. L. R.

Analysis and Testing.

1333. New Method of Determining Iodine Number of Oils and Fats. G. Scotti. *Olii Min.*, 1938, **18** (7), 96–100.—The iodine number of oils and fats is determined as follows: 0·2–0·8 gms. of the material are weighed into an iodine flask and dissolved in 10–15 mls. benzene, 25 or 35 mls. of 2·5% solution of iodine in benzene, and 9 mls. of 10% solution of mercuric acetate in acetic acid are added in turn, agitating the flask after each addition, and the flask allowed to stand for 10 minutes. 20 mls. of 20% potassium iodide are then added, and the flask is shaken vigorously, after which 50–100 mls. of water are added and excess iodine titrated with decinormal thiosulphate solution. A blank determination is made at the same time. A. O.

1334. Identification and Properties of Straight-run and Cracked Residua. A. H. Batchelder and H. B. Wellman. *Refiner*, June 1938, **17** (6), 280.—While cracked residua may be themselves stable, they are not infrequently unstable when blended with straight-run material. Spot tests, such as the Oliensis test, for the examination of cracked blends, are necessarily qualitative, and often hypersensitive. They are sometimes even misleading, it is claimed, since some crudes have been shown to contain a proportion of asphaltic material insoluble in mineral spirit. A quantitative procedure for the estimation of cracked residuum content of fuel oils and asphaltic bitumens is discussed. It is stated that the percentage of material insoluble in *cyclo*hexane minus the percentage insoluble in benzol may be taken as a reliable guide of the proportion of cracked products present. H. G.

1335. Sulphur Determinations from Bomb-Washings Titrations. R. E. Kaufman. *Industr. Engng Chem. Anal.*, 1938, **10** (9), 538–540.—For the correct calorific value of a fuel the gross figure must be reduced by applying the wire correction, the acid correction and the sulphur correction. The wire correction is obtained directly from the heat of combustion of the wire. The acid correction is due to the formation of nitric and sulphuric acids, and is obtained by titration of the bomb-washings with alkali of such strength that 1 ml. is equivalent to that weight of nitric acid the heat of formation of which is 1 calorie. The sulphur correction is due to the fact that, in air, sulphur is oxidized to the dioxide, and in the bomb to the trioxide, coupled with the fact that the sulphuric acid formed is treated as if it were nitric acid in the acid correction. Accordingly, the sulphur correction is the product of the weight of sulphur burnt, and the difference between the heat of conversion of sulphur dioxide to the trioxide and the heat of formation of an equivalent quantity of nitric acid.

The author plots the acid correction (ml. of alkali) against sulphur content, and obtains a straight line. This shows that, for any particular calorimeter, the nitrogen correction is constant, and is unaffected by variation of the calorific value of the fuel between 10,000 and 10,500 cal./gm., and by nitrogen content of the fuel up to 1%. From the equation to the line so obtained the sulphur content can be calculated, provided that the acid correction is known, thus obviating the necessity of determining the sulphur content of the oil.

The author develops this relationship and, writing in a more general form, shows that, once the nitrogen correction has been obtained for any given set-up, the sulphur and acid corrections are both obtainable directly by the one operation of titrating the bomb washings. T. T. D.

1336. Determination of Organic Halogen. R. H. Kimball and L. E. Tufts. *Industr. Engng Chem. Anal.*, 1938, **10** (9), 530–531.—The authors describe a simplified lime-ignition method for estimation of halogens in organic compounds. The sample is weighed in a gelatin capsule, and is introduced into a combustion tube one-third filled with lime. The tube is then almost completely filled with lime, and is placed in a tube furnace, so that the lime between the sample and the open end of the tube is heated to redness before the sample itself is heated. The tube is then pushed into the furnace until the whole of it reaches a bright red heat.

When the sample has been completely burnt, the contents of the tube are transferred to a flask and dissolved in nitric acid. Sulphide is at this stage removed by oxidation with ceric sulphate, excess of the latter being destroyed with hydrogen peroxide. The solution, which may contain free carbon, is then titrated, without filtration, by the Volhard method, with the addition of nitrobenzene to coagulate and stabilize the silver chloride.

A table of results is given showing the accuracy of the method is about $\pm$ 0·2 in the percentage of halogen found. T. T. D.

1337. Determining Dissolved Water in Liquefied Gases. C. W. Perry. *Industr. Engng Chem. Anal.*, 1938, **10** (9), 513–514.—The sample of liquefied petroleum gas or similar product is allowed to expand to atmospheric pressure through two valves. A jet of steam impinges on the first of these to prevent any deposition of water from the vapour as a result of the expansion cooling effect. From the valves the vapour passes through a freezing bulb and escapes, through a gas mater, to the atmosphere. The freezing bulb is immersed in a cooling bath, and the rate of flow of the vapour and degree of refrigeration are so controlled that the bulb remains about half full of the liquefied gas. When sufficient gas has passed through to have left a visible quantity of ice in the freezing-bulb, the flow is discontinued and the cooling bath removed. The bulb is gradually allowed to attain room temperature, the vaporizing gas escaping to the atmosphere through the meter. The increase in weight of the bulb is the weight of water dissolved in that volume of gas which has passed through the meter.

With suitable precautions, an accuracy of $\pm$ 0·005% is claimed, and the method is said to be valid down to a water content of 0·005%. T. T. D.

1338. Improved Method of Heat Imput Control in Glass Fractionating Columns. G. H. Morey. *Industr. Engng Chem. Anal.*, 1938, **10** (9), 531–532.—The kettles of all

glass analytical stills are usually heated by an oil-bath or by electrical immersion-heaters. If the kettles are of more than 5-l. capacity, these two methods become unwieldy. In the method developed by the author, a mantle of thin asbestos cloth is sewn round the flask, and over this is sewn a second mantle of heavy asbestos cloth in which nichrome wire is sewn spirally, from the bottom up. In the case of a 12-l. flask, three circuits of 500 watts power each are suggested. The first mantle is to prevent the heating wire from actually touching the flask at any point. To prevent radiation losses, the flask is insulated by winding asbestos cord over the heating coil. The current in each heating circuit is controlled by a variable resistance, and it is stated that this makes the heating very flexible.

Full details are given of the set-up of a still for use with this type of kettle, and the author claims that once the resistances have been set at the desired point, the column will operate for hours with no attention while one component is being fractionated out.

T. T. D.

1339. Laboratory Columns Packed with Silicon Carbide. H. J. Hall and G. B. Bachman. *Industr. Engng Chem. Anal.*, 1938, **10** (9), 548–549.—The efficiency of ordinary lump silicon carbide as column packing is investigated. Test data are given and comparisons made with other substances, and it is shown that silicon carbide is a very efficient packing. Additional advantages claimed are: (1) it can be used for almost any type of distillation; (2) if necessary, it can be cleaned with boiling chromic acid solution without loss of efficiency; (3) it is cheap, and can thus be discarded if badly fouled.

T. T. D.

1340. Determining Alcohol Percentage in Alcohol-Gasoline Blends. K. Honda. *J. Fuel Soc. Japan*, July 1938, 63, 64.—It has been found that aurine, cyanine and alcohol-soluble nigrosine are insoluble in gasoline, scarcely soluble or almost insoluble in water, but soluble in 95% alcohol. Relative solubilities and colorations obtained are tabulated. Solutions, at varying concentration, of the three agents in alcohol have been prepared, and the resultant colour intensities are discussed. Best results were obtained with nigrosine.

When adding 5×10^{-3} gms. nigrosine to 10 c.c. of an alcohol–gasoline blend, a distinct variation in colour intensity was observed, depending on the alcohol content, and a comparison with standard solutions in a Hehner cylinder is given.

In practice, it is recommended that blends to be tested, should be compared after the addition of nigrosine, with a set of standard solutions containing known percentages of alcohol. The method is claimed to be accurate to 0·5 unit of the alcohol percentage.

L. R.

Motor Fuels.

1341. Conversion of the Middle Oil from Bituminous Shales into Aromatic Hydrocarbons. C. Berthelot. *Monit. Pétr. roum.*, 1938, **39**, 1317–1318.—The increasing production of benzole—recent figures indicate that the world output is now about 1,000,000 tons per year, of which Germany produces 450,000, U.S.A. 386,000, U.K. 184,000, and France 75,000—suggests the value to the petroleum industry of studying the conversion of kerosine and gas oil into low boiling aromatic hydrocarbons.

The most notable works on the subject and the method adopted for experimental purposes in Rumania are briefly summarized. Thermal decomposition and non-catalytic polymerization at temperatures up to 740° C. and pressures of 1 to 2 atms. are used. Controlled conditions avoid carbon formation and reduce gas formation to a minimum.

A typical spirit yielded from kerosine and gas oil is: sp. gr. 0·838; I.B.P. 58° C., 52% at 100° C., 98% at 167° C.; aromatics 83·2%; olefines 4%; naphthenes and paraffins 12·8%; octane no. (C.F.R. Motor) 92; Reid vapour pressure 0·23 atms.; copper dish gum 1·6 mgrms.; doctor test negative; freezing point below −40° C.

T. C. G. T.

1342. Patents on Motor Spirit. Standard Oil Development Co. E.P. 487,745, 20.6.38. Production of high-octane fuel comprising a light hydrocarbon liquid base stock, together with a substantial quantity of methyl normal heptyl ketone and 0·5–5 c.c. of lead tetraethyl in the absence of iron carbonyl.

Standard Oil Development Co. E.P. 487,776, 20.6.38. Process as described in E.P. 487,745 using methyl *iso*propyl ketone instead of methyl normal heptyl ketone.

O. Burmann. E.P. 489,263, 22.7.38. Motor fuel, in particular aircraft fuel, consisting of a mixture of *iso*-ethers produced from residual gases from a polymerization plant.

Universal Oil Products Co. E.P. 490,855, 23.8.38. Preparation of high anti-knock motor fuel by blending liquid hydrogenated polymers of branched-chain structure derived from separate cross-polymerization of *iso*butylene with *n*-butylenes and of *iso*butylene with propylene.

Armour and Co. E.P. 491,102, 26.8.38. Addition of mixed ketones to motor fuel—*e.g.* xylyl alkyl ketone (alkyl group containing at least 8 carbon atoms)—to prevent deposition of carbon during combustion in the engine.

Synthetic Oils and W. W. Myddleton. E.P. 491,778, 8.9.38. Manufacture of motor spirit by passing CO and H_2 in the proportion of 1 : 1·7 by volume over a catalyst containing Ni or Co at 200° C. and under 3 atm. pressure. From the product, a spirit boiling below 150° C. is obtained and separated. The remaining portion is hydrogenated at atmospheric or increased pressure in the presence of a catalyst at temperatures above 120° C., and this further product is fractionated for use as solvents for kerosine, diesel oils and lubricating oils.

W. W. Holland. U.S.P. 2,125,636, 2.8.38. Stabilising gasoline by treating raw gasoline first with alkaline plumbite solution, water-washing it and removing the last traces of alkali with aqueous acetic acid. Excess acetic acid is removed and an inhibitor is added—*e.g.* catechol, monobenzyl, *p*-aminophenol, etc.

C. B. Hillhouse. U.S.P. 2,125,921, 9.8.38. Production of gasoline from hot oil vapours or gas in an unstable form.

J. R. Rose. U.S.P. 2,126,281, 9.8.38. Production of gasoline from still gases by heating the gases to 800–1500° F. and under 200–1500 lb./sq. in. and passing them over a catalyst under this pressure. The catalyst consists of equal proportions by wt. of phosphate rock and fire bond.

J. R. Rose. U.S.P. 2,126,283, 9.8.38. Production of gasoline from still gases by passing the gases under pressure 200–1200 lb./sq. in. at 500–1000° F. in contact with carnatite sprinkled with barium fluoride.

E. R. P. E. Retailliau and J. B. Wyman. U.S.P. 2,126,503, 9.8.38. Straight-run gasoline is refined by passing the vapour through finely divided ferric oxide at 550° F., condensing the vapours and treating the condensate with 98% H_2SO_4 to remove sulphur compounds and increase the lead susceptibility.

R. K. Stratford. U.S.P. 2,127,654, 23.8.38. Refining of cracked spirit using clay.

H. E. Drennan. U.S.P. 2,127,953, 23.8.38. The anti-knock value of motor fuel is increased by passing the vapour at 500–1200° F. over a body of caliche of limestone type at a flow rate to cause a minimum of cracking.

W. E. Kuentzel, T. A. Geissman and H. R. Batchelder. U.S.P. 2,129,142, 6.9.38. The anti-knock properties of motor fuels are improved by contacting them with a catalyst consisting of 85–97% of ferric hydroxide, nickel hydroxide and cobalt hydroxide, 14–2% of aluminium hydroxide and 1% of sodium or potassium hydroxide. The admixture is dried at high temperatures to convert the hydroxide into oxides, and the catalyst is maintained in contact with the hydrocarbons at 850–950° F.

M. Mizuta and T. Yoshimura. U.S.P. 2,131,519, 27.9.38. Refining cracked spirit by treating it with copper naphthenate dissolved in a volatile organic solvent.

W. A. Schulze. U.S.P. 2,131,525, 27.9.38. Process of removing droplets of copper chloride solution from treated oil by filtering it through hair-felt filter.

W. S. E. C.

1343. Patent on Anti-detonants. O. Bormann and J. Pintsch, Komkanditgesellschaft. E.P. 488,405, 6.7.38. Preparation of anti-detonants by treating light liquid hydrocarbons occurring on the production of oil-gas with liquid SO_2. The insoluble hydrocarbon is separatéd, and the SO_2 removed from the dissolved part by distillation leaving an anti-knock agent. W. S. E. C.

Gas, Diesel and Fuel Oils.

1344. Heating Oil Demands Widen the Range of Modern Cracking Operations. G. Weber. *Oil Gas J.*, 4.8.38, **37** (12), 48.—Distillate fuel oils are now commanding special attention in projecting new refining programmes, on account of greatly increased demand and increased prices obtainable for them. The principal product in the group is domestic furnace oil, but diesel fuels for automotive and railroad use, tractor fuels and range oil or kerosine are all included, and demands for them are increasing. Graphs are presented to show the shipments by water of gasoline, fuel and gas oils, and kerosine from twelve refineries in the Houston-Texas City area in 1937 and the trends in refinery prices of two grades of gasoline and two grades furnace oil during the last three years. A considerable share of the increased demand for heating oils had been met by the smaller refiners by suitable plant modifications and by crude selection. Statistics show that weather conditions in the winter affect appreciably the demand and price obtainable for distillate fuels, so that there is greater need for maximum flexibility of plant operation. It must also be remembered that gasoline is still the product of major importance, so that although the trend away from fixed-plant operation is definite and advisable, the planning of economic production must be considered in relation to refinery location, crude supply, price structures, etc. The seasonal peak demands for gasoline and heating oil roughly complement one another. An investigation has been made of several combination units in order to ascertain their maximum flexibility and the extent to which the possible ranges in production of products were utilized. The survey shows that in the units examined the average ranges in production for gasoline, kerosine and distillate heating oils were 40/62½%, 0/14·3% and 2½/30%, respectively, whereas the corresponding ranges actually utilized were approximately 49/60%, 2/10% and 4/15%. R. A. E.

1345. Fuel Possibilities of Vegetable Oils. J. Walton. *Gas Oil Pwr*, July 1938, **33** (394), 167.—An examination has been made of the possibility of using a wide variety of vegetable oils as engine fuels. Of these palm oil, cotton-seed oil, groundnut oil and, in particular, soya-bean oil, appear the most promising. Preheating will be necessary in most cases, owing to viscosity, but there should be no insuperable technical difficulties. On a bench-test a standard-type six-cylinder diesel engine ran with a clean exhaust on palm oil at a consumption figure of 0·416 lb. per B.H.P. hr. On the road the engine required warming up with gas-oil and preheating of the vegetable oil, but with attention to temperature it was possible to operate on a consumption figure 10% above that of gas-oil for 3000 miles. No particular harm was done to the engine, but the pump elements suffered from the poor filtration. Similar results were obtained with cotton-seed oil, ground-nut oil and soya-bean oil, the power output being 91% maximum compared with that of diesel oil. The oils varied in the time required for warming up on gas-oil or paraffin. It is emphasized that the exhaust was invariably clean and diesel knock virtually eliminated. Waste lubricating oil was also used satisfactorily, it being, however, necessary to inject paraffin for starting and to clean the filters more frequently.

In general, the only problems involved are the heating of the fuel oil and the provision of an efficient heated filtration system for the cold fuels. The effect of corrosion by the free fatty acids and the effect on the lubricating oil still require consideration. It has been shown that soya-bean oil has no corrosive effect on metals, whilst palm oil corrodes copper and brass and has a slight effect on nickled or galvanized sheet-iron and ordinary steel. The lubricating oil used appears to suffer a slight initial drop in viscosity, and thereafter it remains steady, although the flash point drops.

Oils with high iodine values—*e.g.*, soya-bean—appear to show the highest residue formation. Theoretically the glycerides, which have no fuel value, should be removed from the oils, but the use of free fatty acids is likely to give rise to difficulties.

C. L. G.

1346. Patents on Diesel Fuel. Texaco Development Corpn. E.P. 488,625, 11.7.38. The ignition quality of diesel fuel for use in internal-combustion diesel engines is improved by adding a small amount of butanone or pentanone peroxide.

F. Uhde and T. W. Pfirrmann. E.P. 490,094, 9.8.38. Manufacture of diesel fuel from difficultly ignitable oils poor in H_2 by treating them with oxygen or an oxidizing gas under increased pressure and mixing the oil with a middle oil rich in hydrogen. W. S. E. C.

1347. Patents on Fuel Oil. Ruhrchemie A.-G. E.P. 491,221, 26.8.38. Production of diesel fuels by mixing paraffinic oils obtained by the catalytic conversion of CO and H_2 at high temperatures and under slightly elevated or reduced pressures, with liquid or solid carbonaceous substances poorer in H—*e.g.*, tar oils—from the dry distillation of carbonaceous substances or the extraction or hydrogenation products of carbonaceous substances.

Standard Oil Development Co. E.P. 491,648, 5.9.38. Production of diesel oil of low ignition temperature by treating petroleum oil of the diesel-fuel type with H_2SO_4 sludge from petroleum refining and sodium nitrate in the presence of a catalyst, α-naphthol. The nitrated fuel is then extracted with aniline. W. S. E. C.

1348. Patent on Kerosine. Edeleanu Gesellschaft m.b.H. E.P. 489,455–489,456, 27.7.38. Low-temperature extraction of light hydrocarbon mixtures using SO_2 and halogen derivatives of hydrocarbons both as solvent and cooling media. W. S. E. C.

Lubricants and Lubrication.

1349. Deterioration of Turbine and Transformer Oils in Service. W. Francis and K. R. Garrett. *J. Instn Petrol. Tech.*, 1938, **24**, 435–440.—Deterioration is discussed from the viewpoint of the chemical changes that take place in oils with use. A method for determining the acidity of these oils using Grignard reagent is described. D. L. S.

1350. The Structure of Lubricating Greases. A. S. C. Lawrence. *J. Instn Petrol. Tech.*, 1938, **24**, 207–220.—Soap-oil systems exist as: (1) true solutions, (2) true gels or (3) pseudo gels. Commercial greases may be in stage 2 or 3. These gels or pseudo gels are crystallizations, and the mechanical properties of the systems are due to the peculiar crystal habit and properties of the separating soap particles. D. L. S.

1351. Contribution to the Study of the Changes Occurring in Lubricating Oils in Internal Combustion Engines. H. Weiss and A. Maillard. *J. Instn Petrol. Tech.*, 1938, **24**, 407–420.—An examination has been made of many samples of used lubricating oils from diesel and gasoline engines, as well as from a single-cylinder engine running on hydrogen and coal gas. A laboratory apparatus has been designed, and a method of test evolved in an attempt to examine the resistance to oxidation of lubricating oils. D. L. S.

1352. Synthesis of Lubricants. G. Hugel (Paper read at the "Semaine de Perfectionnement," École du Pétrole, Strasbourg.) *Rev. Pétrolif.*, 1.7.38, (792), 869.—In the synthesis of lubricants it is a well-known fact that to obtain a high-viscosity index, a viscosity as low as possible should be combined with a molecular weight as high as possible. Although the author mentions that the problem of viscosity is not the only one involved in the development of suitable lubricating oils, the paper is mainly concerned with viscosity phenomena.

The steep viscosity–temperature curve of naphthenic oils, which otherwise possess very valuable characteristics, is explained by the conception of molecular associations, the stability of which is highly dependent on temperature. In order to be able to improve the viscosity–temperature relationship, it is necessary to know the structure

of these associations. When the problem of the viscosity index of cyclic oils is solved the scope of synthesis of lubricants will be considerably widened. It will probably be possible to combine in one molecule the characteristics of cyclic and acyclic hydrocarbons in varying degrees, thus producing oils of widely differing properties.

Finally, the author suggests that it may be possible some day to depart from known viscosity–temperature relations, and even to produce oils, the viscosity of which will rise with increasing temperature. Further developments may lead towards heterogeneous lubricants similar to lubricants occurring in nature which consist of colloidal suspensions in water having a high specific heat which greatly facilitates cooling.

L. R.

1353. Sludge and Sludge Formation in Cracked Residues. J. Voskuil and I. Robu. *J. Instn Petrol. Tech.*, 1938, **24**, 181–206.—The origin and nature of the sludge found in cracked residues are discussed, and a method is evolved for determining the sludge content quantitatively. D. L. S.

1354. Regeneration of Used Lubricating Oils. E. Schmitz. *Mat. Grasses*, 15.7.38, (363), 180–181.—The re-utilization of used lubricating oils is of great importance from a national standpoint. Special lubricating oils, such as transformer and turbine oils, cannot be completely regenerated because of the impossibility of removing all of the peroxides. After simple regeneration and purification, however, they may be used for the lubrication of inferior machine parts, agricultural implements, wagon axles, etc.

For an eventual legislative regulation of the dealings in regenerated lubricating oils, the author suggests the adoption of the following fundamental rules: (*a*) absolute freedom for the user to use his own regenerated oils, and to buy such without limitation, but not to be allowed to sell any; (*b*) conditional liberty for regeneration firms to sell regenerated oils only in specially marked containers; (*c*) complete freedom for the petroleum refiners, and (*d*) complete freedom of the international market. The author concludes that the adoption of such regulations would avoid market disturbances, and provide satisfactory guarantee for the protection of the consumer.

L. R.

1355. Patents on Lubricating Oil. E. A. Evans, A. L. Kelman and C. C. Wakefield & Co., Ltd. E.P. 488,390, 6.7.38. Improved lubricating oil containing 0·1% by wt. of 2-mercaptobenzythiazole alone or together with metal oleates—*e.g.*, Sn, Cr, Pb and Ni.

H. D. Elkington and N.V. de Bataafsche Petroleum Mij. E.P. 488,409, 6.7.38. Preparation of E.P. lubricants by adding to lubricants 10% by wt. of tricresylphosphate.

H. D. Elkington and N.V. de Bataafsche Petroleum Mij. E.P. 488,483, 7.7.38. Improvements in lubricating oils by adding small quantities of ethene and propene trithiocarbonates.

N.V. de Bataafsche Petroleum Mij. E.P. 488,597, 11.7.38. Manufacture of lubricants by adding small quantities ($\frac{1}{4}$%–5%) of high-mol.-wt. polycarboxylic acids obtained by condensation of alkenes and mixtures with maleic acid anhydride and subsequent hydration of the condensation product obtained.

Edeleanu Gesellschaft. E.P. 489,808, 4.8.38. Solvent refining of hydrocarbon oils using a compound of general formula R-(SO_2 : Hal.)n where R is an alkyl or aryl group in which one or more hydrogen atoms may be substituted, Hal represents chlorine, bromine, iodine or fluorine and n is 1, 2, or 3. An auxiliary solvent such as benzene or toluene is also used.

Standard Oil Development Co. E.P. 490,127, 9.8.38. Increasing the viscosity of unsaturated fatty oils by separately hydrogenating lubricating oil and subjecting the hydrogenated oil to a silent electric discharge.

Ruhrchemie A.-G. E.P. 490,930, 22.8.38. Production of lubricating oils by condensation of benzines produced by the catalytic conversion of H_2 and CO mixtures and containing unsaturated hydrocarbons using condensation agents and raising the temperature gradually during the conversion.

A. P. Lowes and I.C.I., Ltd. E.P. 491,522, 9.9.38. Production of synthetic lubricating oils by condensation of benzene and chlorinated paraffin wax in the presence of aluminium chloride as catalyst. The condensation product is then treated with sufficient water to convert the aluminium chloride into hydroxide, and the mixture is heated to 250–300° C. and the lubricant subsequently isolated by filtration, extraction or decantation.

Standard Oil Co. E.P. 491,594, 5.9.38. Production of lubricant which is resistant to gel and cloud formation by adding to mineral oil, basic aluminium naphthenate and oleic or stearic acid.

O. L. Roberts. U.S.P. 2,125,314, 2.8.38. Separating wax from hydrocarbon oil containing solid wax by washing the oil from the wax with a wash solvent containing 0·1–1·0% by wt. of substantially oil-free wax at least a portion of which is in a dispersed solid state.

M. P. Youker. U.S.P. 2,125,325, 2.8.38. Vacuum-distillation of heavy hydrocarbons to recover lubricating oil and separate tars and asphalts.

J. V. Starr. U.S.P. 2,126,055, 9.8.38. Dewaxing hydrocarbon oils using acetone or isopropyl alcohol.

D. S. McKittrick and H. J. Henriques. U.S.P. 2,126,493, 9.8.38. Dewaxing hydrocarbon oils in a two-stage process using chlorex and secondary butyl alcohol.

L. A. Clarke. U.S.P. 2,127,325, 16.8.38. Solvent refining of hydrocarbon oils using aniline and recovering the aniline by mixing the oil and aniline with anhydrous CO_2 under pressure. An addition compound is formed which is immiscible with the oil and decomposes on reducing the pressure to atmospheric.

E. W. Adams and F. H. Maclaren. U.S.P. 2,127,668, 23.8.38. Production of wax of high-tensile strength by incorporating paraffin wax with 10% of petroleum wax from Salt Creek crude oil, the admixture having a m. pt. above 135° F. and an oil content no greater than 2%.

V. Voorhees. U.S.P. 2,127,708, 23.8.38. Propane dewaxing of hydrocarbon oils.

W. B. Hendrey. U.S.P. 2,128,029, 23.8.38. Solvent refining of hydrocarbon oils as described in U.S.P. 2,127,325, using phenol as solvent which is recovered by means of anhydrous ammonia.

J. W. Poole. U.S.P. 2,128,885, 30.8.38. Solvent extraction of hydrocarbon oils using furfural, phenol and nitrobenzene and recovering the available asphalt.

M. Mueller-Conradi and R. Uloth. U.S.P. 2,128,958, 6.9.38. Solvent extraction of hydrocarbon oils using as solvent a mixture of nitrobenzene and acetonitrile.

J. M. Page, Jr. U.S.P. 2,129,282, 6.9.38. Solvent extraction of hydrocarbon oils using $\beta\beta^1$-dichlordiethyl ether to which 5–20% of propylene glycol has been added to avoid separation of wax as a third phase.

W. Grote and A. Hopper. U.S.P. 2,129,616, 6.9.38. Dewaxing of hydrocarbon oils using SO_2 benzol.

A. A. Wells and D. F. Edwards. U.S.P. 2,129,751, 13.9.38. Improved centrifuge for the separation of petroleum oil from reagents with which it has been contacted.

J. M. Whiteley. U.S.P. 2,129,752, 13.9.38. Dewaxing of hydrocarbon oils using a halogenated hydrocarbon heavier than wax and a wax-modifying agent produced by the condensation of active derivatives of paraffin wax, and then dechlorinating these derivatives.

M. Pier and F. Christmas. U.S.P. 2,130,024, 13.9.38. Production of synthetic lubricating oils by condensing paraffin wax and a naphthalene nucleus as a constituent part of its structure.

S. W. Ferris. U.S.P. 2,130,126, 13.9.38. Production of lubricating oil of high-viscosity/gravity constant by treatment of hydrocarbon oil with cresylic acid.

O. H. Milmore. U.S.P. 2,130,147, 13.9.38. Counter-current treatment of hydrocarbon oil using as solvents SO_2 or ethyl alcohol and propane.

R. B. Selund. U.S.P. 2,131,303, 27.9.38. Removal of wax from rotary filters in dewaxing processes.

A. P. Anderson. U.S.P. 2,131,422, 27.9.38. Solvent extraction of hydrocarbon oil using cresylic acid containing 0·3–1·0% of a separating aid—*e.g.*, water, methyl alcohol, glycerol, or glycol—in the presence of a liquid auxiliary solvent (hydrocarbon boiling below 45° C.). W. S. E. C.

Asphalt and Bitumen.

1356. Deposits and Characteristics of Italian Rock Asphalt and Production of Carburants. F. Cardia. *Le Strade*, 1938, **20** (7), 423–425.—Reference is made to a previous paper in the above journal which dealt with the distillation of rock asphalt. It is pointed out that deposits of rock asphalt and bituminous shale are very widespread, and the extent has been determined in only a few cases, for which figures are given. Ragussa rock asphalt is a limestone non-uniformly impregnated with bitumen, which varies from 2·4% at the top of the vein to 6–8% at the bottom, whilst Abruzzi rock is a uniformly impregnated calcareous rock with a bitumen content of 7% at the top of the vein to 21% at the bottom. Del Lazio rock consists of pieces of rock embedded in bituminous cement, and is believed to yield larger amounts of oil than the Ragussa and Abruzzi. The composition of a number of asphalts is given. Discussing methods of separating the organic material from the mineral, it is pointed out that solvent extraction is possible only with impregnated limestone, and operating costs are high. A method of recovery described in *Le Strade*, 1937, **12**, consists in heating the rock in an oven (Roma-Forno) at a suitable temperature to release the oil without cracking and decomposition of the carbonate. Risk of cracking is reduced by continuous circulation of the oil vapour through the oven. A semi-industrial plant operating on Abruzzi rock containing 11·70% bitumen yielded 9·4% of oil of 0·9757 sp. gr., and from Ragussa rock of 9% bitumen content, 7·65% of oil of 0·9863 sp. gr. After treatment, these oils gave a motor spirit which gave good results, although not comparable with a normal fuel. It is believed that by hydrogenation of the oil a yield of 80% of benzine could be obtained. A. O.

1357. Properties of Asphaltic Bitumen in relation to the Road. F. H. Garner. *J. Instn Petrol. Tech.*, 1938, **24**, 496–512.—This paper reveals the wide gap which exists between the physical and chemical properties of asphaltic bitumen, and a knowledge of their influence on road behaviour. D. L. S.

1358. Properties of Road Tars, Effect of Exposure. J. G. Mitchell and D. G. Murdock. *J. Soc. chem. Ind.*, **57** (5), 137–148.—The results of investigation of the effect of evaporation, oxidation and exposure to light on the setting properties of road tar are discussed. Experiments in an air-current thermostat in the dark confirmed the results of Adam and colleagues, in that low-aromatic tars gave a low but nearly constant loss at 25° C., whilst high-aromatic tars gave a rapid loss at first—but the rate afterwards decreased, and at 35° C. both types behaved similarly. Formation of skin is attributed chiefly to evaporation of oil from the surface at a greater rate than that at which it can be replenished by diffusion from the underlying tar; oxidation and polymerization have a less important effect and probably toughen the existing skin. Skin formation was determined by measurement of time taken for penetration by a steel ball after exposure of the tar in the air current thermostat at 25° C. for 48 hrs. and again after stirring sample. Increase in viscosity produced by removal of oil by

vacuum distillation was similar to that caused by evaporation in dark, and viscosity changes may be followed by loss in weight measurements. Oxidation experiments showed that absorption of oxygen occurred in the dark at ordinary temperatures, and was accelerated by light; this was accompanied by increase in free carbon and viscosity. On exposure of tar out of doors, grey islands of skin, which eventually join up, are formed: the surface then becomes matt, and cracking may occur. In the dark the surface remains bright and smooth, but wrinkling may occur with ultra-violet light. Evaporation in a thermostat produces a skin permeable to oil vapour, whereas in the open an impermeable skin is formed; this accounts for apparent cessation of evaporation and sudden losses usually accompanied by cracking of skin, which occurs only in the early summer. A. O.

1359. Use of Coloured and Decorative Asphalt for Roads and Buildings. D. C. Broome. *J. Soc. chem. Ind.*, 1938, **57** (4), 99–106.—This paper gives an account of the present state of development of the coloured asphalt industry. Principal types of materials employed are: mastic, rolled asphalt, rock asphalt, materials using coloured aggregates, traffic-sign mixtures and paints. In the manufacture of coloured mastic, finely ground, hard calcareous or siliceous limestone with a minimum of 70% calcium carbonate is recommended, and colour, surface texture and capacity for absorption are of great importance. Bitumen must be light in colour, and hardness, ductility and proportions used must be carefully adjusted. In the examples given blends of natural and refinery bitumen were used. Large amounts of pigment are generally necessary, and most organic pigments are either "swamped" by the bitumen or destroyed by heating. Similarly, many inorganic pigments are adversely affected by heating. Lead pigments are avoided owing to possibility of poisoning, and metallic oxides are chiefly used. Owing to cost, colour is usually red, but brown, green, blue and grey mastics are available. A reflexion colourimeter has been developed for measuring pigment–bitumen colour. The nature of the pigment is shown to have a bearing on mechanical properties of the mastic. The softer bitumen in rolled asphalt permits the use of a much lighter bitumen and lower percentage of pigment. The aggregate is much larger, and crushing strength and resistance to abrasion must be such as to prevent disintegration under traffic. The only colour commercially available for rolled asphalt is red. Mixtures are prepared in the ordinary manner at about 250° F. the pigment and filler being added last; laying and rolling is also carried out as usual, and, if desired, dry chippings of suitable colour or chippings coated with coloured bitumen may be rolled in. In addition to pigmented mastics, a wide range of decorative materials may be obtained by loading the mastic with natural-coloured chippings, which, in certain cases, greatly improve heat insulation. For traffic-sign mixtures a special type of white or yellow mastic, containing marble, sand and barytes and a high proportion of pigment, is used. A. O.

1360. Some Developments in Bituminous Paving Practice in Canada. M. F. MacNaughton. *J. Soc. chem. Ind.*, 1938, **57** (30), 700–703.—This paper is also a contribution to the discussion of Dr. Stradling's paper. It is stated that no central research organization exists in Canada, but most of the provinces have laboratories attached to the Highway Department in which some research is carried on. The considerations which governed the adoption of thin bitumen carpets for reconstruction of the main trunk highways in the Eastern Provinces are enumerated. Deposits of gravel and sand suitable for use in the base course and in the bituminous wearing surface are widespread. The base course varies in thickness from 4 ins. over stable consolidated sub grades to 3 ft. over unstable grades, and is treated with bituminous primer. The wearing surface is generally a 3-in. layer of plant-mixed bituminous concrete consisting of crushed gravel passing 1-in. screen continuously graded to high density; a maximum abrasion of 25–30% by the Los Angeles method is stipulated for the aggregate, and 3·5–4·5% of 85–95° F. softening-point bitumen. The optimum bitumen content for open-graded mixtures is determined by stability tests and for dense graded mixtures by determining the amount of bitumen necessary to produce maximum density on compaction by pneumatic vibration. Investigation of mixtures in service are said to show that this method of compaction gives results equivalent to 3 or 4 years traffic on road as regards density and degradation of aggregate. A. O.

1361. Observations on the Mechanical Testing of Bituminous Road Mixtures. J. P. Pfeiffer. *J. Soc. chem. Ind.*, 1938, **57** (7), 213–224.—It is shown that the methods of test for determining tensile and comprehensive strength of solid materials are unsuitable for the examination of bituminous road materials and the difficulties attending the application of mechanical tests and analysis of results are discussed. The various factors governing the resistance to deformation of a plastic material are considered, and the theory underlying the principles of a test based on soil mechanics are explained. The apparatus is illustrated, and results of examination of various materials are considered. A. O.

1362. Highway Research in the United States. R. W. Crum. *J. Soc. chem. Ind.*, 1938, **57** (30), 697–700.—In a contribution to the discussion of Dr. Stradling's paper, "Building and Road Research in Great Britain," a brief account is given of the work of the Highway Research Board. In connection with bitumen specifications, it is stated that standards formerly developed for materials from a few sources with established service records are not applicable to bitumens now produced by new methods and from new sources. The need for research in connection with tests to measure more directly the properties affecting behaviour of road surfaces and with aggregates and soil stabilization is stressed. A. O.

1363. Durability of Asphalt. D. M. Wilson. *J. Soc. chem. Ind.*, 1938, **57**, 148–151.—The chief factors affecting durability of asphalt mixtures are said to be the properties of the bitumen, the manner in which the bitumen is mixed with suitably graded aggregate, and relative proportions of bitumen and aggregate. Bitumen undergoes rapid changes in properties during the manufacture of some types of asphalt, and, when laid, hardening is slow, although more rapid on the surface than within the mass. The extent of oxidation undergone by the bitumen during mixing is indicated by the penetration-softening-point relation of the recovered bitumen. For rolled asphalt the bitumen should be slightly in excess of the amount required to fill the voids and seal the mixture when laid; insufficient bitumen results in undue hardening during mixing and excess to marking and pushing when laid. A method of determining the amount of bitumen required consists of measuring the height of cylinders prepared with the same amount of aggregate and increasing the amounts of bitumen compressed under load of 12,000 lb. per sq. in. at 100° C. The height of the cylinder falls to a minimum and then increases, and the percentage of bitumen chosen should be greater than the minimum. In mastic asphalt the bitumen must be sufficiently high to assist in floating the mastic, and must be much harder than in rolled asphalt. A high proportion of finely-divided material is required to provide stability, which is best measured by the hardness-number test. The durability of compressed asphalt is greatly affected by the penetration of the bitumen in the finished material and the bitumen-carrying capacity of the rock asphalt; the amount of bitumen is less than that required to fill the voids and coat the grains, and, in order to obtain a waterproof surface, the bitumen must be softer than in mastic or rolled asphalt. A. O.

1364. Multiple Softening-Point Apparatus for Bitumen. D. M. Wilson. *J. Soc. chem. Ind.*, 1938, **57** (33), 767.—It is stated that it is only possible to make duplicate softening-point determinations on one sample at a time with the standard apparatus, and that it is difficult to ensure uniform temperature conditions in the glycerine bath. An apparatus capable of dealing with four samples in duplicate, embodying mechanical stirring and electrical means of heating at the standard rate, is described and illustrated. Results of sufficient accuracy may be obtained quickly by filling the rings, cutting off excess bitumen after allowing to set and immersing the rings in water at 0° C. for 10 mins. before commencing the test. A. O.

1365. Asphaltic Bitumen Cutback, Emulsions and Bituminous Materials. W. Becker. *Asph. u. Teer*, 1938, **38** (24), 365–372.—The author discusses the German specifications for bituminous materials. The consumption of bitumen in Germany in 1937—550–6,000,000 tons, of which 50–60% is used in road construction—is said to be twice that of 1934. Specifications for a wide range of asphaltic bitumens are given in DIN 1995, issued in March 1938, and recommendations as to the types of bitumen to be used for

various forms of construction are given in DIN 1996 and in instructions issued by the General Inspector of Roads. Only one grade of cutback is specified in DIN 1995, and this must contain tar oil or a mixture of petroleum distillate and tar oil in the proportion of 15–20% of the cutback. The bitumen is type B 80, having a (K. & S.) softening point of 31–35° C. In order to increase adhesion to wet aggregates, small amounts of high-molecular-weight, saponifiable materials or organic bases may be mixed with the cutbacks; cutbacks for soil stabilization are not standardized and their composition and properties are generally determined by the user. Three grades of emulsion of different stability are specified, and the bitumen used is generally type B 200, but B 300 and B 80 may also be used. For tar–bitumen mixtures the specification requires the use of 85% of standard road-tar and 15% of 40–50 penetration bitumen, but mixtures containing as much as 40% of tar or bitumen are also employed. Road-tar is required to pass a bitumen mixing test and heating test, even when it is not intended to be mixed with bitumen. The road-tar must give an homogeneous mixture when blended with 20% of 40–50 penetration bitumen, and a mixture of 15% of bitumen and 85% tar must remain homogeneous when heated. The specification for joint filler for paving-stone, given in DIN 1996, requires the use of 55% of bitumen of 36–40° C. (K. & S.) softening point and 45% of mineral filler. The specifications for bitumen joint filler for concrete, issued by the General Inspector of Roads, require a bitumen having a softening point of 55° C. (B. & R.) minimum and maximum deformation of the joint filler of 5 by the Nüssel ball test. No details of composition are given, but the severe requirements can be met only by the use of a mixture of powerded and fibrous filler. The various specifications are reproduced, and tests of mixtures meeting certain of the specifications are given. A. O.

1366. Application and Methods of Testing of Bituminous Emulsions. G. H. Klinkmann. *Asph. u. Teer*, 1938, **38** (25), 406–410; **38** (26), 419–342.—In a satisfactory commercial emulsion the size of the particles is approximately 0·002–0·003 mm. This property can only be accurately examined by means of a microscope, but an indication of the suitability can be obtained by visual examination of the colour and appearance on a rod and by the sieve test. DIN 1995 allows 0·5% of material retained on a No. 40 sieve. A minimum viscosity of 3° Engler is prescribed for emulsions of normal viscosity, but for high-viscosity emulsions a minimum viscosity of 30 secs. at 20° C. in the road tar viscometer with 4-mm. jet is specified. Bitumen content is determined by distillation with xylol or by the Marcusson method; the latter method is considered the most reliable. It is stated that good or indifferent results may be observed with the same emulsions and the same dry stone when a difference of 1% is made in the bitumen content. Examination of the composition and proportion of emulsifier is difficult, but an approximate indication may sometimes be had by determination of ash content, extraction of the bitumen obtained by the Marcusson method and by determination of total and free alkali. The properties of the bitumen used may be determined on the material obtained by the Marcusson method or by drying out 15 gm. of emulsion on a porous plate; the latter gives sufficient bitumen to determine softening point and thread length by the drop-point method. In tests for storage stability the tendency to sedimentation and creaming should be taken into account, as well as separation of aqueous liquor. In this connection it is pointed out that the terms stable and unstable should be used only when mineral stability is under consideration. The test for resistance to low temperatures is applied only to emulsions used for maintenance work in the winter; the emulsions should not coagulate after cooling to − 80° C. for 1 hr. The principal factor in the breaking of emulsion in use is said to be the adsorption of the constituents of the emulsifier on the stone surface, and in the official specification breakdown is examined by mixing the emulsion with standard basalt; the author, however, considers the method devised by himself using the stabilometer to be more satisfactory. A modification of this apparatus has been produced for use with high-viscosity emulsions. A. O.

1367. Patent on Asphalt. A. A. Wells and J. O. Collins. U.S.P. 2,131,205, 27.9.38. —Manufacture of asphalts by distilling crude oil, separating the low-boiling fractions from the residual oil and separating the asphalt from the residual oil by means of solvents—*e.g.*, phenol, cresol, furfural. W. S. E. C.

Special Products.

1368. Control of Blue Mold of Tobacco with Benzene Vapour. P. W. Gamuer. *Industr. Engng Chem.*, 1938, **30**, 1076.—All fresh sporation is stopped by maintaining a concentration of 0·05% benzene vapour over the plant-bed. The vapour concentration is best maintained by covering the beds with wet cloth covers; even evaporation is obtained by means of wick evaporators of suitable design. A special M.S.A. gas detector, calibrated for benzene, has been found to be satisfactory for measuring the concentration of benzene in the tobacco-plant beds. J. W. H.

1369. Patents on Special Products. A. Carpmael. E.P. 488,519, 7.7.38. Insecticide comprising calcium chloride in cinnamic alcohol or its esters or ethers or benzyl benzoate, together with emulsifying, dispersing or thickening agents.

G. W. Johnson. E.P. 490,785, 22.8.38. Manufacture of oxidation products from paraffin wax.

W. W. Groves. E.P. 491,143, 26.8.38. Catalyst consisting of an alloy of more than 50% of Pt and containing Ru and at least on of the following: Os, Ir, Rh, Pd, W, V, Zr and Th, in the form of a gauze, sieve, spiral or perforated plate. When vanadium and tungsten are used, they are recrystallized by heating before use.

Standard Oil Development Co. E.P. 491,199, 29.8.38. Manufacture of cellulose compound compositions.

H. G. Schneider and J. V. Sommer. U.S.P. 2,131,195, 27.9.38. Preparation of drying oils by subjecting vapour-phased cracked gasoline (fraction boiling between 40–108° C.) to the action of an oxygen-containing gas at 200–230° C. and at pressures above 1000 lbs./sq. in. W. S. E. C.

Economics and Statistics.

1370. Question of National Motor Fuels in France. L. Jonasz. *Monit. Pétr. roum.*, 1938, **39**, 1169–1170.—France consumes 3,725,300 tonnes of liquid fuel per year, 2,250,000 being gasoline, and the home and colonial production is negligible.

As an alternative to petroleum, the hydrogenation of coal is not favoured, as, apart from the uneconomic features of the process, France is already importing one-third of her coal requirements. The only really important point in favour of hydrogenation is the possibility of the production of high-quality fuel, for aircraft, in time of emergency.

Other alternatives, such as low-temperature carbonization, bituminous shales, vegetable oils, alcohols, gases, electricity and producer gas vehicles, are reviewed. It is concluded that petroleum will continue for some years to be the main source of fuel. T. C. G. T.

1371. Development of Production in Venezuela. Anon. *Rev. Pétrolif.*, 23.9.38 (804), 1223.—In the first half of this year the Venezuelan oil production was 13,341,000 metric tonnes, a 7% increase on that for the corresponding period of 1937. Important increases have been obtained from the Tia–Juana region, a northern prolongation of Lagunillas, which has developed very quickly since March 1937. Bachaquero, 19 km. from Lagunillas, has also been the scene of important developments. In Eastern Venezuela the production for the first six months of 1938 was 2,311,000 tonnes, a rise of 187,000 tonnes as compared with the first six months of 1937. Numerous wells have been drilled in the new field of Temblador. G. D. H.

1372. Visit to the Albanian Oil-fields. M. Cristescu. *Monit. Pétr. roum.*, 1938, **39**, 1397–1399.—Italians made the first successful drilling in Albania in 1913. Oil was struck at 75 m., but the area was abandoned owing to poor yields. Between 1921 and 1925, several companies, notably the Standard Oil and the Anglo-Persian, investigated the possibilities of Albania, but only the latter company did so thoroughly, and in the Patos area found rich deposits at shallow depth. The oil was, however,

very heavy, of poor quality, and contained much sulphur, and in 1931 the area was abandoned.

The Italians have realized the importance, to them, of the potential oil supplies and are working a concession in the Berat district, very extensively. Two hundred wells varying in depth from 400 to 700 m. are now producing 350 tonnes of crude per day. The Italians aim at 1000 tonnes per day, and are drilling fifteen–twenty wells a month. They are using twenty-six rotary drilling units of German manufacture and driven by diesel motors. A 73-km. pipe-line transports the oil from Kueova, in the Berat district, to the strategic port of Valona, which latter port is dominated by the Italian fortified island of Sazano. The recent rapid growth of production is illustrated by the following figures: In 1933, 1700 tonnes of oil were produced and 6000 m. drilled; in 1937 the figures were 93,456 tonnes of oil and 42,202 m. drilled. One thousand five hundred Albanian labourers and three hundred Italian technicians, etc., are engaged and Albania receives 600,000 gold francs per year from the concession.

The French have done a little exploiting, but it has been of little importance.

T. C. G. T.

BOOK REVIEWS.

Modern Methods of Refining Lubricating Oils. By Vladimir A. Kalichevsky. Pp. 235. American Chemical Society Monograph Series. New York, Reinhold Publishing Corporation. (London: Chapman & Hall. 30*s.* net.)

The publication of this volume as one of the American Chemical Society Series of Scientific and Technologic Monographs is in itself sufficient assurance of its being a work of high standard. When, in addition, the author is a member of the staff of the Research and Development Laboratories of the Socony-Vacuum Oil Company, Inc., and is himself well known for his work and writings in the field dealt with, the assurance may be doubly sure. This, in fact, it is; for the monograph under review is an outstanding contribution to the literature of lubricating oils. It is also timely. During recent years great changes have been taking place in the methods of producing lubricants from natural petroleum. Solvent extraction processes are more and more replacing the older conventional methods of refining by means of sulphuric-acid and earth treatment. Other solvent processes are taking the place of the now-obsolescent naphtha dewaxing procedure. These new methods are already so well established and understood that an authoritative text-book gathering together the available information in a non-controversial manner and critically surveying the whole field is very welcome.

Moreover, the technology of lubrication is itself in a state of flux. The needs of new machines and the demands of special and more onerous conditions of operation have called for correspondingly special properties in the lubricants employed. At the same time that greater stability at high temperatures has proved necessary in certain directions—as, for example, in internal-combustion engine-cylinder lubrication—improved resistance towards oxidation has been found equally necessary in others. Increased load-carrying capacity and greater oiliness have gone hand in hand with improvement in viscosity index and pour-point. These and other effects have been largely produced by the use of "additives"—synthetic chemicals frequently having little or no relationship to the lubricating oil itself. Some factitious aids to lubrication are assuming ever greater commercial importance, and incidentally are throwing considerable light on the mechanism of lubrication.

Kalichevsky's book is the first known to the reviewer which deals intimately and with real knowledge of the new science and practice of the use of additives. That he has combined this aspect of the manufacture of lubricants with a detailed and systematic account of their basic refining by modern methods is a tribute not only to his knowledge of the subject, but also to his ability to see it as a whole and to present a clear picture of the present-day position to his readers. As may be gathered from the foregoing, the range of the work is wide, and appears to be complete. The detail is splendidly done. The author never does less than provide personal and critical discussion of his subject-matter. Yet he invariably supplies the data without which such a work would lack the desired authority. Altogether some 700 references are cited. In the section dealing with solvent dewaxing alone there are 123. It seems scarcely possible that a book containing this number of references (and well cross-referenced) should be so easily readable.

The method of treatment is as follows:

The first two chapters deal with the properties of refined oils and modern refining methods. Then come four chapters on waxes and dewaxing, of which the afore-mentioned section on solvent dewaxing is naturally the most important. This accounts for a third of the book. The second one-third is devoted to de-asphaltizing and the use of selective solvents. This part is particularly informative, and alone would ensure acceptance of the book as a standard exposition of the subject. The chapter dealing with variables involved in refining oils with selective solvent has been written in collaboration with T. A. Petry.

The last five chapters are concerned with the fascinating subject of the

additives. Pour-point depressants, viscosity index improvers, and oxidation inhibitors get the best showing; but oiliness might have been dealt with more fully and apart from the load-carrying capacity of the extreme-pressure agents. One can also foresee future editions dealing with that increasingly troublesome condition of ring-sticking and its cure.

The volume is beautifully printed and produced. The author, the editors of the series and the publishers are alike to be congratulated. S. J. M. AULD.

Petroleo. By C. E. Nabuco de Araujo, Jr., in collaboration with, L. Mariti, P. C. Barbosa, J. R. Da Costa, M. J. Da Rosa and H. E. Araujo. Pp. 511. J. R. De Oliveira & Co., Rio de Janeiro. 1936. (In Portuguese.)

This book is published under the auspices of the engineering section of the Standard Oil Company of Brazil, its six co-authors being members of the latter organization in positions of technical importance.

The work is divided into eight sections or chapters, dealing respectively with geology, the composition of the principal commercial products, refining, lubrication and lubricants, asphalt and bituminous products, the manufacture and testing of greases, the modern chemistry of petroleum and finally with general methods of analysis.

The impression conveyed to the mind of the reader is that this field has been traversed in leaps and bounds, rather than by a process of peaceful penetration into a little-known country. The section on geology, for instance, springs from an eight-page exposition of all the known theories of origin to a description of some experiments, presumably to be carried out by the reader, which are supposed to demonstrate the influence of capillarity upon the migration of oil. The remainder of the chapter deals in a very sketchy manner with some well-known geological facts.

The second chapter devotes only some seven pages to the composition of the principal commercial products, these being preceded by six pages descriptive of the hydrocarbons generally. These latter would more usefully have been incorporated in chapter VII. On page 55 there is a table giving the names of the principal products derived from petroleum with their chief applications; this will be useful to those interested in modern nomenclature.

The chapter on refining describes in rather unnecessary detail, cracking, polymerization, hydrogenation and solvent-extraction processes. Other modern refining and distillation processes are ignored, although sweetening methods are dealt with in the chapter dealing with the chemistry of petroleum.

The section on lubrication and lubricants is very elementary, and conveys no information relative to the progress made in recent years with respect to this important branch of the subject.

The two chapters on asphalt and lubricating greases, respectively, are excellent summaries, and represent quite the most useful contributions to the book.

Chapter VII, with the somewhat portentous title "Modern Chemistry of Petroleum and the Basis of Industrial Chemistry," occupies nearly 37% of the whole volume. It is a treatise in itself, and might well have been separately published as such.

It contains a great deal of matter which is only indirectly connected with the petroleum industry, and which only serves to confuse the issue, if the latter, as affirmed in the preface to the book, is mainly concerned in the progress made in the science of petroleum.

To mention only a few of these digressions from the main subject, there are two whole pages devoted to the physiological effects of *iso*propyl alcohol, a dissertation on cellulose solvents and the viscosity of nitrocellulose solutions, including nine pages descriptive of the glycols, five pages dealing exclusively with the ethanolamines, some eleven pages relative to electrolytic methods for oxidizing hydrocarbons and descriptions at length of such well-known substances as chloroform and carbon tetrachloride.

On the other hand, the fifty-nine pages devoted to the sulphur compounds and methods of sweetening contain much useful information culled from recent literature.

The final chapter, dealing with the analysis of petroleum products, gives a some-

what attenuated version of the customary test methods; in some cases the degree of attenuation seems unnecessarily drastic, as, for instance, the inclusion of a comparison table for colour determinations by the Robinson and N.P.A. colorimeters, but with no description of the former, and only an illustration of the latter. Again, on page 262 is illustrated an apparatus which is not referred to in the text until thirteen pages later, where its object is dismissed in four lines, no description of the appliance or the method of using it being included.

The book concludes with some tables, a bibliography, a list of authors, and a general index. Mention may be made of the exceptionally clear and easily read type used throughout the work, and of the illustrations, which are well reproduced.

J. McConnell Sanders.

Proceedings of the XIIth International Congress of Acetylene, Oxy-Acetylene Welding, and Allied Industries, London 1936. 6 vols. Pp. 1566. The British Acetylene Association, 64 Victoria Street, S.W.1. Price £1 1*s*.

The *Proceedings* consist of six volumes totalling 1566 pages, and comprise a record of the papers, discussions and other proceedings of the Congress during the Meeting in London in 1936.

The Congress began with an inaugural ceremony at the Guildhall, and the proceedings, and an exhibition of welding were held at the Caxton Hall, London. The last two similar Congresses were held in Zürich in 1930 and Rome in 1934. The next is to held in Munich in 1939.

As the title suggests, the Congress is almost entirely concerned with acetylene and oxy-acetylene welding, although some reference is made to electric welding, notably a comparison between the results obtained with modern methods of oxy-acetylene welding and electric-arc welding, and a note on a system of simultaneous training in oxy-acetylene and electric welding.

The *Proceedings* are printed in English, German and French, and translations or *résumés* in the other two languages are provided for each paper, of which there is a total of seventy-four, profusely illustrated with photographs and diagrams.

Amongst the many papers dealing with various aspects of the subject may be noted a number on welding and cutting and the use of dissolved acetylene and acetylene generators in various countries, the metallurgy of weld metal and testing mechanically and by the use of X-rays and the weldability of various steels.

A number of papers deal with metal-coating and with case-hardening with the acetylene flame and hard facing.

The technique of welding and its influence on the properties of welds and the training of welders are dealt with.

Under-water cutting using oxy-hydrogen and lead-burning have been given consideration, and a number of other aspects of this wide subject.

The *Proceedings* are well indexed and well printed, and provide a valuable compendium of information on a subject of vital importance to petroleum technologists.

A. C. Hartley.

BOOKS AND PUBLICATIONS RECEIVED.

History of the Gas Industry. By Louis Stotz in collaboration with Alexander Jamison. Pp. 534. Stettiner Bros., New York.

The "History of the Gas Industry" is primarily concerned with an account of the development of the industry since 1900. A very brief description is given of the development of gas manufactured in the early years of the nineteenth century, but primarily with reference to the United States. Throughout the book attention is given to the development of various applications of both coal-gas and natural gas, under such headings as cooking, water heating, gas irons, space heating, laundry applications, incinerators and refrigeration. An account is also given of the development of various pipe-line systems for natural gas, and the last chapter, which occupies about a quarter of the book, is on "The Regulation of Public Utilities."

The " History of the Gas Industry " has a number of illustrations which are rather poorly reproduced, but it does collect together a lot of miscellaneous facts on this subject with special reference to the use of natural gas.

Report of the Road Research Board for the Year Ended 31st March, 1938. Pp. viii + 191. H.M. Stationery Office. Price 4*s*.

Among laboratory investigations described in the Report now brought to the point of full-scale testing is work on bituminous surfacing mixtures. The simplest forms of test devised for bituminous materials have been applied to the determination of the most suitable binder contents for different types of aggregate, filler and binder. The measurement of the bulk density of fillers when suspended in benzene has shown that a definite relation exists between this property and the optimum proportion of filler to tar.

For measuring the temperature inside bituminous road carpets during laying and rolling, an electrical thermometer is used with which a thermojunction is formed at the point of a hypodermic needle.

British Standard Specification No. 914, for Mild-Steel Drums for Lubricating Oils. October 1938. Pp. 11. British Standards Institution, 28, Victoria Street, S.W.1. Price 2*s*.

This specification refers to cylindrical mild-steel drums suitable for the transport of lubricating oils. Two classes of drums are provided for. Class 1, for use generally in the home trade, and Class 2, a slightly heavier drum for export. The specification covers the construction and dimensions of these drums.

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Geology.

1373. Criteria for Determining the Time of Accumulation under Special Circumstances. S. C. Herold. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 834–851.—The time of accumulation is closely related to the geological history of the area. This history, in so far as it affects accumulation, may be divided into nine periods. Deposition, compaction and cementation are followed by marginal elevation and geosynclinal folding. Following this, migration and accumulation of oil and gas may take place. Then comes secondary folding of the anticlines and a further period of accumulation. The remaining four periods are truncation or subsidence of marginal uplands, tertiary folding at anticlines, a period of relative tranquillity and the present epoch. Pools may be divided into two classes, according to the effect of the truncation or subsidence of the marginal uplands. In the first class this effect has been excessive, and such pools are found in the Palæozoic. Pools belonging to the second class are found in the Cenozoic. At present it is not possible to classify the Mesozoic pools.

S. E. C.

1374. Origin and Accumulation of Oil Sagely Debated. L. G. E. Bignell. *Oil Gas J.*, **37** (16), 1.9.38, 23–24.—When studying the origin of oil, it is noted that most oilfields occur in sedimentary rocks, and it is therefore right to presume that oil is formed from materials included in these rocks. W. E. Pratt has pointed out that most of the oil in the United States has been found in the younger sedimentary rocks, and although oil may have been formed in the older beds, it has, with a few exceptions, been dispersed by earth movements and other agencies.

Dr. E. Berl has formulated a theory based on the idea that oil is formed from asphaltic material, and that during transformation aliphatic, aromatic and hydro-aromatic hydrocarbons are formed. He also discusses the decomposition of carbohydrates, lignin and its derivatives by bacterial decay, heat and pressure, and postulates the theory that water-soluble carbohydrates were formed from plant bodies. These sunk to greater depths, and by the introduction of alkaline materials were transformed into proto-products, asphalts and, finally, crude oils. Migration took place when the superincumbent pressure caused the water to migrate into the shales, and the oil was able to take its place in the pore-space of the sand. The oil and gas would then tend to travel upwards to the highest point in the reservoir and float on the water, and, provided a good cap-rock existed, would remain trapped.

The areas of the Mississippi Valley and the plains on both sides of the Ural Mountains have both been very stable throughout geological history, and may possibly contain large oil-pools awaiting discovery.

J. A. G.

1375. Subsurface Tertiary Zones of Correlation through Mississippi, Alabama and Florida. D. W. Gravell and M. A. Hanna. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 984–1013.—As an aid to subsurface correlation, the authors take fifteen zones ranging in age from Miocene to Wilcox. Reference is made to the distribution of the zones in the Gulf Coast, particularly in Mississippi, Alabama and Florida; the characteristic fossils contained in them are discussed and profusely illustrated.

Experience shows that these zones are marked by numerous large species of foraminifera which have limited vertical range but wide geographical distribution.

Three cross-sections showing the distribution of certain zones are given, mainly to assist palæontologists who have examined the samples, to know where the larger foraminifera are found and to help them in the recognition of such fossils in future wells. Facies changes are discussed.

G. S. S.

1376. Comparison of Permian Ammonoid Zones of Soviet Russia with those of North America. A. K. Miller. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1014–1019.—Extensive studies of the Permian deposits of Russia have in recent years been made by Russian geologists, and much information has been obtained in regard to the ammonoid zones of that system. The data now available are used by the author to compare these zones with those of Western Texas.

The zone of *Properrinites* which is found in the Wolfcamp horizon of the Texas

region is represented in the Urals and in Crimea. The Leonard horizon (*Perrinites* zone) is represented in the Urals, Pamirs and Darwaz, and the Word (*Waagenoceras* zone) in Crimea and the Pamirs. From the Capitan horizon (*Timorites* zone) no ammonoids are known in Russia.

A general correlation of these ammonoid-bearing beds of Russia with those of Western Texas is also given in tabulated form. G. S. S.

1377. Petroleum and Natural Gas in Non-marine Sediments of Powder Wash Field in North-west Colorado. W. T. Nightingale. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1020–1047.—The Powder Wash field is situated within the drainage system of Little Snake River in Moffat County, North-west Colorado.

The original gas-discovery well was drilled in 1931, and was completed at 2152 ft., giving 34,000,000 cu. ft. per day. In 1936 a deep test-well was made, and at 5014 ft. an oil-saturated sand was encountered which produced at the rate of 1100 brls. of oil per day. Production occurs in continental deposits confined to the Hiawatha member of the Wasatch formation (Lower Eocene).

The stratigraphy and tectonics of the region of the field are described, and a table of the formations, as exposed or drilled in North-west Moffat County, is furnished. The group and formations present extend from the Dakota Sandstone through the Colorado and Montana (Upper Cretaceous) into the Wasatch and Green River formations (Eocene), and Brown's Park formation (? Miocene).

The following conclusions are reached: (1) oil and gas present in the non-marine deposits of the Powder Wash field are indigenous to the Wasatch formation in which they are found; (2) theories embracing either vertical or long-distance lateral migration into the present reservoir sands from distant sources are quite untenable; (3) accumulation is controlled by a domed structure, which is modified by the shape and continuity of lenticular sands within the fold or dome itself; (4) fields developed in continental sediments, such as the Wasatch of the Rocky Mountain region, involve greatly increased drilling hazards, because of irregular and uncertain conditions of hydrocarbon generation and the extreme lenticularity of reservoir sands. G. S. S.

1378. Wilmington Oilfield, Los Angeles County, California. E. J. Bartosh. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1048–1079.—The Wilmington field is located 20 miles south of Los Angeles, and adjacent to Los Angeles Harbour.

The following formations are represented: Middle and Upper Eocene, consisting of shales (some diatomaceous) and sandstones, the Upper and Lower Pliocene (Pico and Repetto) composed of hard sands and shales with many concretions, and the Pleistocene, which consists of sands, clays and gravels, lying unconformably on the Pico.

Structurally, the field may be described as a regional anticlinal uplift forming an irregular-shaped dome with much faulting. Six normal faults and one minor reverse fault occur. The major movements apparently began near the close of the Miocene, and continued progressively throughout the Lower Pliocene.

Production is obtained from the Repetto (Lower Pliocene) and Puente (Upper Miocene); there are five producing zones: Tar, Ranger, Upper Terminal, Lower Terminal and Ford. A total of 17,608,495 brls. has been produced from the field from December 1936 to February 15, 1938. Potential production for February 1938 was 185,754 brls. daily, and the latest (2nd March) actual production was 101,382 brls. daily from 374 wells, having a daily average per well of 271 brls.

A sub-surface structure map, a number of vertical and cross-sections, and a series of production curves accompany the paper. G. S. S.

1379. Subsurface Geology and Oil and Gas Resources of Osage County, Oklahoma. N. W. Bass and others. *U.S. Geol. Surv. Bull.*, 1938, 900a, 1–45.—The four townships (Tps. 22 and 23 N., Rs. 10 and 11 E.) described in this bulletin are situated in South-east Osage Co., 12–25 miles north-west of Tulsa; they contain more than 1800 wells. Production is obtained from eleven beds, all of which lie at depths of less than 2600 ft. Nine of the oil- and gas-beds are in the Pennsylvanian series, one is in the Mississippian and one in the Ordovician system. The Bartlesville Sand (Pennsylvanian) has yielded oil and gas in more wells than all the other beds combined.

The rocks have a regional dip to the west at an average rate of about 40 ft. to the mile. This dip, however, is not uniform; it is interrupted by anticlines and synclines, most of which have a structural closure of less than 100 ft. on the Oswego lime.

In the Ordovician sediments, and to a less extent in several of the older beds, oil seems to be concentrated in the domes and anticlines. In the Bartlesville sand, and probably in some of the other sands, accumulation is controlled by the distribution of the reservoir beds rather than by their structural position.

Investigation shows that there are several localities outside the oilfields in the townships discussed, where prospecting may reveal new oil and gas deposits. In Osage Co., and elsewhere in the adjoining portion of the Mid-Continent region, recent work shows that additional oil can be obtained by treating the limestone reservoir beds with acid. Further production will also in due course be obtained by repressuring and water-flooding in fields that derive their oil from the Bartlesville, Cleveland, and other sandstone reservoir beds.

A large folding map of the townships showing the subsurface structure, producing beds in oil and gas wells, and other data, accompanies the bulletin. G. S. S.

1380. Cowley County is Staging Comeback with Deeper Wells. D. Dalrymple. *Oil Gas J.*, 18.8.38, **37** (14), 26–27, 32.—The Weathered Pool was discovered in 1935 and developed in Arbuckle Lime. In 1937 the Kansas City Lime was found to contain oil, and recently the Mississippi Lime at 3150 ft. was also found to be productive. The last discovery is on the southern end of the anticline, and has so far been proved in two wells a mile apart.

Several other fields in this area have proved production from the Bartlesville Sand. The Rainbow Bend Pool was developed in sands at the base of the Pennsylvanian forming a lens on the south-east flank of an anticline trending N.N.E.–S.S.W.

Most of the oil in this area is associated with definite structures, but porosity and lensing conditions control production to a great extent. J. A. G.

1381. Potentialities of Eocene Series in West Central Louisiana and East Texas. P. Thomas. *Oil Wkly*, 19.9.38, **91** (2), 30–40.—Most of the oil in the Gulf Coast region is thought to have originated in the shales interbedded with the producing sands which were deposited along ancient shore-lines. Estimates of probable future production of the various formations is based on the hypothesis that the most favourable area is where the facies are intermediate between dominantly marine and dominantly continental in character.

The Midway Series is almost completely composed of clays, and forms a good cap-rock over the underlying Cretaceous beds. The Wilcox changes from a continental to a marine series in a southerly direction, and south of the Angelina-Caldwell flexure should prove productive on favourable structures if the formation remains within drilling depth. The Carrizo and Queen City formations are both about 100 ft. in thickness, and display shore-line conditions only in the western part of the area. They have not been very well tested, but, in any case, are probably too thin to be of major importance. Of the Recklaw, Weches and Cane River formations only the Weches has produced oil. They are all predominantly marine in character, and therefore probably do not contain extensive reservoir sands. The Sparta Sand varies in thickness from 500 ft. in Louisiana to 200 ft. in East Texas. It is predominantly marine in character, and consists of massive sands interbedded with sandy clays and lignites. One field produces from this horizon, and it is possible that further discoveries will be made in the area south of the district considered favourable for Wilcox production.

The Crockett and Cook Mountain beds lie between the Sparta and Cockfield formations. At outcrop they display shore-line conditions, but gradually become more marine down-dip. Thin sand zones will probably be found to be productive on suitable structures within the same area thought to be favourable for Sparta production. This also applies to the Cockfield formation, which is already productive in the southern part of the area.

A small amount of oil has been obtained from the Jackson group, but owing to the fact that the beds are composed mainly of clays and shales, it is not considered a probable source of economic production. J. A. G.

1382. Two Strikes Twelve Miles Apart Enhance Vicksburg Trend. E. S. Post. *Oil Wkly.*, 12.9.38, **90**, 73–76.—Two wells drilled in South Texas on the same north-south anticlinal axis have both discovered oil in what is thought to be basal Frio or the top of the Vicksburg. The Kelsey well found the oil sand at 4730–4748 ft., and production was 2–3 brls. per hour, with a high gas pressure. The other well—McKinney No. 1—12 miles to the south, reached the producing horizon at 4842–4858 ft., and is believed to be a better producer than the Kelsey well.

Definite correlation in the area has not yet been worked out, but it is probable that the beds dip steeply in an easterly direction, and the total length of the anticline is estimated at 35 miles. Should the producing sand found in these recent tests prove to be extensive, it will probably develop into an important horizon in this area.

J. A. G.

1383. General Features of Michigan Structural Geology. R. B. Newcombe. *Oil Gas J.*, 15.9.38, **37** (18), 24–26.—Recent work in this region has identified at least five different structural provinces. The Howell anticline is the largest known structure of its type in the State. It extends north-westwards from the north-east end of the Cincinnatti Arch, and may be related to it in some way. Parallel to the Howell structure are several smaller folds.

The Saginaw area to the west contains several anticlines which trend slightly more east-west than the Howell structures, and after interruption west of Saginaw, develop again into broad noses. Like the Howell structures, these folds increase in sharpness from south to north and have a steeper dip to the west, or basinwards side.

North, east and west of Mount Pleasant are three series of structures which are all productive. Those to the east are the most important, and accumulation in this area seems to be due to a flattening of the regional dip. The northern area is largely unknown, but several structures have been discovered which produce small amounts of gas. The structures to the west of Mount Pleasant are small closures on broad terraces situated where north-east–south-west or east–west folding intersects the north-west–south-east regional folding.

Several structural noses occur in the central-western area which plunge towards the east, and where they intersect with the gentle north-west–south-east folds, a number of oil-pools have been discovered.

South-western Michigan lies on the Kankakee Arch, and the formations are not so much affected by the main basin to the north-east. Several oil-pools have been located here on north-west–south-east folds. Production is from the Traverse, and it is expected that further discoveries will be made. J. A. G.

1384. Geology of the Clare County Field in Michigan. R. B. Newcombe. *Oil Gas J.*, 6.10.38, **37** (21), 25–27, 34.—In the central portion of the Michigan Basin there is a series of anticlinal structures which trend north-west–south-east and plunge in the latter direction. Two main fields have been developed here: the Vernon Pool and the Freeman-Redding or Van Horn field. There is evidence of several areas of closure on this trend, but two exploratory wells have failed to find oil, probably because they were located too far east or north-east of the crest of the structure.

The limits of the Freeman-Redding field are not yet determined, but although the structural relief is not very great, it broadens considerably to the north. It is possible that the area of closure is due to the intersection of the Vernon and Wise axes of folding. A terrace to the north of the Freeman-Redding field has produced only small amounts of gas, but it is expected that oil will eventually be discovered here.

The north-west extension of the trend is not well determined. Geophysical work is being done, and with the aid of a few test-wells it is hoped that further areas of closure will be discovered.

Most of the production is obtained from the Dundee limestone or the dolomitic Monroe Series. It is generally admitted that the Bell was deposited on the eroded surface of the Dundee, and in some areas the whole of this latter formation appears to have been removed, in which case the Bell Shale rests directly on the Monroe Series. It has not yet been decided to what extent accumulation is due to these conditions of unconformity and how much is due to folding. J. A. G.

1385. Birk Discovery Stimulates Exploration in Kentucky. D. Dalrymple. *Oil Gas J.*, 27.10.38, **37** (24), 90–94, 130.—The Birk structure is a series of plunging anticlines trending north-east–south-west. Associated with the folding is a fault trending in the same direction, and which is apparently part of the Rough Creek fault system. Faulting probably took place soon after the close of Pennsylvanian times. Production is from a zone of loosely cemented oolites in the McClosky Series. Of the other formations, the Chester seems to be complete, and the Barlow Sand is unusually sandy. The Bethel Sand thickens, and contains less shale than in the area to the south.

J. A. G.

1386. The Foraminifera of the South German Dogger-δ. O. Kuhn. *Petrol. Z.*, 1938, **34** (31), 3–7.—The various species found in this zone of the Dogger are described and references given.

S. E. C.

1387. The Lower Schlier in Austria. G. Göbzinger. *Petrol. Z.*, 1938, **34** (31), 1–3.—Two deep wells were drilled near Eisenhub during the period 1920–1927. The first was 1219 m. deep, and the second 1250 m., but this was later deepened to 1533 m. This second well gave practically a complete section through the Schlier, and the part from 1000 to 1533 m. is described in the present paper. The upper part was dealt with in earlier publications. A study of the cores showed that local disturbances were present, and that conditions are such that structures suitable for the accumulation of oil and gas might be expected. The presence of a bituminous clay 300 m. thick points to the Schlier being a possible source-rock.

S. E. C.

Geophysics.

1388. Magnetic Studies in Alsace. C.-L. Alexian. *Ann. des Comb. Liq.*, 1937, Nov.–Dec., **12** (6), 1085–1158; 1938, Jan.–Feb., **13** (1), 53–110.—The precision and sensitivity of the Haalck variometer, its errors, their avoidance and correction are described. The field methods and difficulties are discussed, and a table of magnetic susceptibilities and detailed tables of the values of ΔZ for 506 stations are given.

The methods of calculation proposed by various authors have been applied to a number of simple geometrical forms, and it was found that only certain of them are applicable. For flat structures it was deduced that modified forms of the calculations of Haanel, Tiberg and Koenigsberger can be used. For elongated structures Koenigsberger's and the modified Thalén formula are of service.

The distribution and form of the magnetic anomalies permit certain conclusions to be reached with regard to the magnetic masses. A description is given of the method of interpretation, together with qualitative results of the connection between the geology and the magnetic anomalies of Alsace. A N.N.E.–S.S.W. trend is indicated, and the large Saverne–Sarrebourg anomaly is related to that of Gundershoffen, where a Tertiary basalt outcrops. The Pechelbronn oil basin is marked by a zone of negative anomalies. Such is the case for most of the world's oilfields. The presence of a large fracture has been deduced, and there are evidences of a basaltic mass at depth in the 48° 10′–47° 45′ area.

The paper is illustrated with numerous sections, diagrams and maps of the anomalies. See also Abstract No. 1402.

G. D. H.

Drilling.

1389. Rotary Drilling in Poland. H. Gorka. *Kop. Naft. Polsce*, 1938, **8** (8), 227–229.—The paper gives a comprehensive review of the state of rotary drilling in Poland as compared with other countries. The costs of investments and drilling are given in tables, and the progress of drilling in the past year is shown in diagrams.

E. J. W.

1390. Drilling Patents. K. Bolton and J. E. Weller. U.S.P. 2,131,868, 4.10.38. An apparatus for cementing oil wells, consisting of a plug adapted to be pumped into the well and a batch of fluid cement, a measuring-line connected to the plug and automatic means for feeding the line into the well.

A. C. Catland. U.S.P. 2,132,014, 4.10.38. Core-catcher.

W. H. Collins. U.S.P. 2,132,015, 4.10.38. A combination viscometer, hydrometer and gel-testing device for determining drilling-fluid characteristics. It consists of an open-top container with a valve to control the viscosity tube, mounted centrally in the base through which the fluid will pass by gravity, indicia on the container to indicate its contents or its degree of immersion for determining specific gravity and gelling characteristics.

C. L. Walker. U.S.P. 2,132,061, 4.10.38. A removable quick-action whipstock, consisting of a whipstock and a clutch and means for actuating the clutch at the surface to cause the clutch to grip the casing and means for releasing the grip.

F. J. Beckman. U.S.P. 2,132,717, 11.10.38. A method of logging the formation by filling the hole with material capable of being removed by drilling through it, the drilling to enlarge the bore and to remove the material and carry the cuttings to the surface.

R. T. Mobley. U.S.P. 2,132,747, 11.10.38. A pipe-gripping means for rotary equipment, consisting of an elongated, flexible element carried spirally about the drill-pipe and means forming a part of the gripping device permitting longitudinal movement of the pipe, but not rotary movement, independent of the rotary table.

C. B. Patton. U.S.P. 2,133,564, 19.10.38. A well-drilling apparatus of the rotary type, comprising a power unit and a tool unit, this unit comprising a tool-member mounted for movement between an operative position where it drills and under reams the hole below the casing, and an inoperative position for permitting movement through the casing to and from the working position. A drill-stem is rotated by the power unit and connected to the tool member, so that longitudinal movement of the stem will cause movement of the tool member between operative and inoperative positions.

W. A. Abegg. U.S.P. 2,134,095, 25.10.38. Rotary well reamer.

C. B. Holt. U.S.P. 2,134,164, 25.10.38. A rotary bit comprising a body including an attaching portion and a rounded work-end, and having a chamber in this end opening outwards. A second chamber is attached, and guide-grooves connect the chambers. In the first chamber is a fluid-actuated wheel and sprockets in both chambers, and an endless cutting mechanism supported by the sprockets. The cutting mechanism consists of a number of rotatable cutters. Fluid is admitted to the first chamber for driving the wheel.

P. F. Matlock. U.S.P. 2,134,287, 25.10.38. Whipstock. L. V. W. C.

Production.

1391. Production Patents. H. A. Schmidt. U.S.P. 2,131,822, 4.10.38. A well-pumping apparatus having a barrel at the lower end of the tubing and a plunger reciprocable in the barrel, having a discharge port into the tubing and a travelling valve in the plunger. A sealing means between the barrel and tubing and an outlet valve controlling the port in the barrel, and means for controlling communication between the upper end of the barrel and the tubing above the sealing means.

M. O. Johnston. U.S.P. 2,132,072, 4.10.38. Formation tester.

J. D. Nixon. U.S.P. 2,132,081, 4.10.38. Well-flowing device.

J. E. Hall. U.S.P. 2,132,161, 4.10.38. Insertable circulation starter for oil-well strings.

J. R. Yancey. U.S.P. 2,132,199, 4.10.38. Well installation with choke valve.

E. Hollyfield. U.S.P. 2,132,477, 11.10.38. Sucker-rod swivel.

D. H. Reed. U.S.P. 2,132,645, 11.10.38. Outside pipe-cutter.

G. S. Knox. U.S.P. 2,132,645, 11.10.38. Gas lift-pump.

C. L. Dickard. U.S.P. 2,132,781, 11.10.38. Polished rod-grip.

R. P. Simmonds. U.S.P. 2,133,050, 11.10.38. Sucker rod and combined coupling and torsion joint.

C. J. Coberly. U.S.P. 2,133,272, 18.10.38. Means for draining oil-well tubing.

W. C. Erwin and C. H. Sweet. U.S.P. 2,133,383, 18.10.38. Well cleaner.

F. McManis. U.S.P. 2,133,462, 18.10.38. Well packer.

I. J. McCullough. U.S.P. 2,133,628, 18.10.38. Well pipe-cutter.

W. J. Brundred. U.S.P. 2,133,730, 18.10.38. An apparatus for producing oil having a tubing string with a plurality of packers mounted circumferentially on the tubing, and arranged to isolate the various strata pierced by the well from each other, and a plurality of pipes extending downwards within the tubing, and having their ends in communication, through the wall of the tubing, with strata having varying characteristics of permeability.

G. A. Humason. U.S.P. 2,134,044, 25.10.38. Tubing head.

G. A. Humason. U.S.P. 2,134,045, 25.10.38. Well flowing-device.

F. L. Pivoto. U.S.P. 2,134,200, 25.10.38. Plug-valve casing-head.

C. C. Taylor. U.S.P. 2,134,320, 25.10.38. Well cleaner, comprising a number of packers eccentrically mounted in spaced relation with each other, a cylinder and a piston free to be reciprocated within the cylinder.

S. A. Scherbatskay and J. Neufeld. U.S.P. 2,134,428, 25.10.38. A device for surveying the level of liquid in a drill hole comprising a sound generator.

C. C. Hogg. U.S.P. 2,134,610, 25.10.38. Apparatus for heating oil-bearing sand to increase oil production. L. V. W. C.

Transport and Storage.

1392. Making Soil Corrosion Survey by Using Electrolytic Test. I. A. Denison. *Oil Gas J.*, 22.9.38, **37** (19), 96.—The electrolytic test for measuring corrosiveness of soils described by I. A. Denison (*Bur. Stand. J. Res. Wash.*, 1936, **17**, 363), and by K. H. Logan, S. P. Ewing and I. A. Denison (A.S.T.M. Symposium on Corrosion Testing Procedures, 1937, 95), has been shown to be closely related with the practical tests instituted by the Bureau of Standards, etc. An accurate record of leaks and replacements made on an extensive pipe-line system provided an opportunity to correlate the results of the electrolytic test with corrosion experienced under actual operating conditions. As the test was successful in measuring the corrosiveness of a large percentage of the soils along the right of way of a 128-mile section of this pipe-line system, it would appear that the test might be used practically in deciding to what sections of a prospective pipe-line coatings should be applied.

The test method is fully described, and operating hints are given. The pipe-line system consisted of five parallel 8-in. lines installed at various times, some constructed of wrought iron and some of steel, originally unprotected and of an average age of 33 years. Analysis of the data on leaks and reconditioning showed a rough proportionality between number of leaks per unit length and percentage of line reconditioned, also that no more reconditioning was done than was necessary to maintain the condition of the system. After 10 or 15 years the curves for leaks per unit length of line and cumulative percentage reconditioned against the time were approximately linear. The corrosiveness of twenty-seven soil types was determined, and the results were compared with the number of leaks which had developed on the pipe-lines in the soil types during the period of operation of the system. Grouping the results into five arbitrary ranges of average current density and of leak frequency showed

that the electrolytic test correctly predicted the corrosiveness of about 70% of the soils.

Based on the data obtained on the pipe-line system discussed, and assuming a similar maintenance policy, a method for making a corrosive survey for pipe-line installation is presented. This comprises mapping of the soils along the right of way, collecting samples at intervals of at least every ½ mile, testing the samples by the electrolytic method, and averaging the values for each soil type and arranging the soils in order of decreasing corrosiveness according to the test method. From the formulæ developed as a result of the pipe-line surveyed and the calculated costs of coating and maintenance, a graphical method has been developed, by means of which it can be ascertained whether it is more economical to lay coated or bare lines in a particular soil type. R. A. E.

1393. Casting Sulphur Pipe. I. Bencowitz. *Petrol. Engr*, Sept. 1938, **9** (13), 40.—The use of compositions containing sulphur for acid and electrolyte-resisting jointing and sealing compounds, and in the construction of floors, sewers, acid tanks, etc., is being extended to the fabrication of pipe and the lining of steel pipe. Sulphur pipe is manufactured in a jacketed mould, rotating at 1000 r.p.m. The mould is started cold, and first lined by feeding in a small quantity of molten sulphur. The lining sets, and is coated with fine coke, and a quantity of coarse aggregate added, followed immediately by a mix of molten sulphur containing, *e.g.* sand, coke, gravel and asbestos. The mould is rotated until compaction is complete, and then heated with steam, which melts the sulphur lining, allowing the finished pipe to be withdrawn.

Steel pipe may be lined by first applying an interior coating of a bituminous material, and then centring a steam-heated core, round which the sulphur mix is poured. After solidification the core is removed.

Sulphur pipes are unaffected by temperature changes and corrosive liquids, and can be made to withstand an internal pressure of 95 lb. per sq. in., and to have a crushing strength of 860 lb. per sq. in.

The composition and properties of various sulphur pipes are tabulated.

C. L. G.

1394. Aluminium Paint in the Oil and Petroleum Industry. Anon. *Petrol. Times*, 10.9.38, 1026 (40), 348.—Aluminium pigment is now produced by a wet process, and comes on to the market as a paste ready for incorporation in a suitable medium. Its complete opacity, high resistance to corrosion and humidity and high reflectivity render it a valuable material for the protection of outdoor equipment. It does not replace the conventional primers. Its high covering capacity—800–900 sq. ft. per gallon on surfaces of average porosity—and its low specific gravity—1·0 approx.—make it as economical as the best lead-pigment paint. When used on petroleum storage-tanks its life is up to 6 years, and it is of proved efficiency in reducing evaporation losses by virtue of its high heat reflectivity. Its light colour, high light-reflecting capacity and "easy-to-clean" surface are valuable attributes when used on interiors.

H. G.

1395. Effect of Corrosion on the Durability of Paint Films. V. M. Darsey. *Industr. Engng Chem.*, 1938, **30** (10), 1147.—Chemical pretreatment of metals to convert their surfaces into more stable and less reactive phosphate coatings increases the durability of applied paint coatings. Peeling or chipping of the paint is retarded by increased adhesion to the base metal.

Paints containing corrosion inhibitors have greater durability than similar products without inhibitors.

Failure of paint coatings has a beginning at the point of contact of paint with metal surface, and a schedule for painting should include both composition of paint and pretreatment of the metal prior to application. H. C. R.

1396. Pretreatment of Metal Surfaces for Painting. F. N. Spellar. *Industr. Engng Chem.*, 1938, **30** (10), 1152.—The advantages of proper cleaning of metal surfaces prior to painting are discussed and the use of inhibitors both in the descaling solutions and in the priming paint coats advocated. H. C. R.

Crude Petroleum.

1397. Refining Characteristics of Illinois Crude Oils. G. Egloff, G. B. Zimmerman, and J. C. Morrell. *Oil Gas J.*, 27.10.38, **37** (24), 87.—The discovery of new pools during the past two years has directed attention to the Illinois field, where production is now at the rate of about 33 million brls. per annum. The refining characteristics of eleven crudes in the new production area are considered. Despite variations in formation and depth of production, the oil is relatively uniform in quality. The average properties are: A.P.I. grav. 37–39°, water and sediment usually below 0·5%, sulphur content 0·12–0·18%. The low cold test and viscosity contribute to ease of pipe-line transportation. In general, the oils appear similar to Mid-Continent crudes. Analyses, estimated laboratory yields on straight distillation and estimated skimming and cracking yields, from crudes obtained from Clay City, Centralia, Clinton County, Becher City, Lawrence County, Marion County, Richland County, Wayne County, are tabulated. In evaluating the crudes, the method employed was to remove straight-run gasoline with kerosine or gas oil. The residues remaining after the successive fractions were removed and inspected to determine their cracking characteristics, and the yields of products by cracking these residues in a Dubbs unit were estimated. In order to bring the entire gasoline yield to 70–72 L-3 octane rating, re-forming of the straight-run gasoline, or of the naphtha remaining after removal of 69–70 octane number light fraction, was taken into consideration. Polymerization of the entire cracked gas, using the catalytic process, was also included, and the resulting polymer gasoline was blended with the cracked and re-formed products.

As typical oils representing one of the largest producing areas, two crudes from Clay City were examined, and the principal results may be summarized as follows:

Gravity of crude in A.P.I. °	36·7	39·5
Light gasoline 70 octane, % vol.	8·7	—
Yields after cracking, reforming, etc.		
Total gasoline, % vol.	70·7	44·5
Total residuum, % vol.	20·0	—
Gas oil, straight-run, % vol.	—	29·8
Total furnace and fuel oil, % vol.	—	18·4
Loss, % vol.	9·3	7·3
Octane number of gasoline L-3 method	71/72	72/74
Octane number of gasoline C.F.R. motor method	69/70	70/72

The straight-run gas oil from the crude of 39·5° A.P.I. gravity is of low cold test, and is satisfactory from the standpoint of use as diesel fuel. The gasolines are of low sulphur content, and may be treated by conventional methods to give water-white products, or may be made marketable by addition of anti-oxidant and dye. A sulphur distribution carried out on products obtained from Weiler Sand crude, Clay County, shows that the bulk of the sulphur is found in the crude residue, and that the light distillates are characterized by comparative freedom from H_2S and also low mercaptan content. Details for the other crudes are given. R. A. E.

1398. Specific Gravities of Polish Crude Oils. K. Katz. *Kop. Naft. Polsce.*, 1938, **8** (8), 230.—Tables are given for the specific gravity of crude oil from different parts of Poland. The average figure for the specific gravity of the oil in any particular place has been calculated from the formula $d = \frac{M_1 + M_2 + M_3 + \ldots}{V_1 + V_2 + V_3 + \ldots}$ where $M_1, M_2 \ldots$ = the production in tons, $V_1, V_2 \ldots$ = the production in cubic metres of the different bore-holes and d = the mean specific gravity of the oil. E. J. W.

1399. Petroleum from K.M.A. Pool Analyzed. Anon. *Petrol. Engr*, August 1938, **9** (13), 86.—A Bureau of Mines analysis of crude oil from the deep K.M.A. producing zone in Wichita and Archer counties, Texas, indicates that it is an intermediate base oil with a gravity of 43·8° A.P.I., a sulphur content of 0·21% and a viscosity S.U. at 100° F. of 35 secs. Yields are as follows:—

Light gasoline	15·6%
Total gasoline and naphtha	40·8%
Kerosine	10·7%
Gas-oil	13·4%
Non-viscous lub. dist.	9·0%
Med. lub. dist.	6·0%
Residuum	15·8%

C. L. G.

1400. Desalting Crude Petroleum. A Review of the Literature. L. F. Christianson and J. W. Horne. *U.S. Bureau of Mines. Report of Investigations* 3422.—This report is a compilation of information found in the literature on the problem of desalting crude petroleum. The deleterious effects of salt in petroleum on refinery equipment and processes are discussed, and methods in use to-day for the removal of salt from petroleum are described. B. T.

1401. Patent on Crude Oil. S. E. Campbell. U.S.P. 2,133,186, 11.10.38. Breaking of crude oil emulsions by allowing a stream of the emulsion to pass at 150–212° F. into zones containing NaCl of 10–25% salinity and into a zone containing finely-divided contact material. W. S. E. C.

Gas.

1402. Gas Measurements above Petroleum Deposits. G. Selzer and R. Weber. *Petrol. Z.*, 1938, **34** (39/40), 10–11.—The presence of petroleum at depth is shown at the surface by the diffusion of hydrocarbon gases—almost exclusively methane. The amount of these gases is very small, and their measurement has presented great difficulties. A new apparatus has been designed and built, however, and with this exact measurements can be made in the field. The results are plotted in the form of isogas lines—lines along which the gas concentration is the same. To illustrate the application of the method the results of two surveys are given. S. E. C.

1403. Patents on Gas. A. A. Thornton. E.P. 491,299, 30.8.38. Process of removing organic sulphur compounds from fuel gases containing hydrogen—*e.g.*, coke-oven gas, town gas, water gas—from which H_2S has been removed, by passing the gas over Cu as catalyst at 600° C. The reaction products formed are removed by absorption agents—*e.g.*, first moistened and then dry lime.

G. W. Johnson. E.P. 491,657, 5.9.38. Process of washing out hydrocarbons from gas mixtures.

I.G. Farbenindustrie. E.P. 492,503, 21.9.38. Separation of propane and propylene from gas mixtures by washing with liquefied normally gaseous halogenated hydrocarbons—*e.g.*, ethyl chloride and recovering the propane and/or propylene from the washing agent by known methods. W. S. E. C.

Cracking.

1404. Patents on Cracking. Houdry Process Corp. E.P. 487,785, 23.6.38. Process and apparatus for the catalytic treatment of hydrocarbons and regeneration of the catalyst used.

W. T. Hancock. U.S.P. 2,129,174, 6.9.38. Lining for oil-cracking tubes.

J. K. Roberts. U.S.P. 2,132,129, 4.10.38. Manufacture of high anti-knock gasoline by subjecting heavy petroleum residues to viscosity breaking, segregating the gasoline produced, and subjecting it to reforming.

H. V. Atwell. U.S.P. 2,133,240, 11.10.38. Cracking of hydrocarbon oils to produce gasoline in which the oil is first de-asphalted with a solvent and the de-asphalted oil is then cracked, and the asphaltic material is injected into the oil undergoing cracking. W. S. E. C.

Hydrogenation.

1405. U.S. State Hydrogenation Research. Anon. *Fuel Economist*, 1938, **14** (155), 292–297.—This article describes the work now being carried out in the U.S. Bureau of Mines for the benefit of the U.S. coal industry.

A resume is given of the plant in use, and its operation, together with a short account of some of the results obtained. W. E. J. B.

1406. Research into the Production of Motor Fuel from Low-temperature Tar. B. Wieclawek. *Przem. Naft.*, 25.10.38, **20**, 553–558.—The paper endeavours to show that petrol produced from low-temperature tar by separation from the distillation products of coal and from middle and heavy oils by hydrogenation under pressure furnish adequate motor fuels.

I. *Petrol Obtained from Distillation Products of Coal.* 400 kg. of primary tar, obtained in the process of semi-coking of coal (up to 600° C.), were distilled in portions, the fraction up to 230° C. being taken. This fraction was redistilled and a fraction up to 170° C. obtained. It still contained up to 10% phenols and 2% pyridine bases, which were removed by refining with a 20% solution of sodium hydroxide and an 80% solution of sulphuric acid. The product obtained was colourless, and had a characteristic aromatic smell. It did not change its colour, nor were dark resins precipitated when exposed to sunlight for 60 days. The petrol has a specific gravity (at 20°) = 0·8526, heat of combustion = 10393 cal./kg., H : C ratio = 1·5, and its mean boiling temperature = 142·7° C.

Another type of petrol was produced by absorption on active carbon of the gases during the process of semi-coking. The petrol resembled the one previously described, but when exposed to light its colour changed to yellow, and resins were precipitated after 60 days. Its specific gravity at 20° C. = 0·776, heat of combustion = 10408 cal./kg.; H : C ratio = 1·7, mean boiling temperature = 87·5° C. A chemical analysis showed that "absorbed" petrol contained about 50% more unsaturated and about 75% more paraffin hydrocarbons than the straight distilled petrol. It contained, however, 30% less naphthenes. The knock ratings of the two petrols were determined by the C.F.R. motor method, 78 and 80 being the octane numbers of the absorbed and the straight distilled petrol, respectively.

II. *Petrol from Middle and Heavy Oils.* This petrol was produced by hydrogenation under pressure of the middle and heavy oils from the primary tar, in the presence of a molybdenum catalyst. The yield was 30% on the amount of oils used. For the product so obtained the following data are given amongst others: specific gravity 0·794, heat of combustion 10,717 cal./kg., H : C ratio = 1·6, mean boiling temperature = 115° C., octane number 75·6.

III. *Comparison of Results.* A table is given in which the results and data obtained for the different petrols are compared. E. J. W.

1407. Oil and Spirit from Water Gas and Coal Gas. Anon. *Fuel Economist*, 1938, **14** (155), 285 and 290.—The article describes the process which will be carried out by the installation now going in at Bedlay Colliery, near Glasgow.

The process is being operated by Synthetic Oils, Ltd., using a gas containing a carbon monoxide/hydrogen ratio between 1 to 1 and 1 to 1·5. Apparently the spirit produced has an octane number of 65.

It is claimed that it is possible to work the plant so that a satisfactory motor spirit and a high-grade diesel fuel can be obtained at the same time. Later developments make it possible to use either blue-water gas, Tully or Pintsch gas as the raw material.

The first battery of cells of the new plant will treat 150,000 to 200,000 cu. ft. of gas per day, producing, it is claimed, 136–138 gals. per day of synthetic oil.

W. E. J. B.

1408. Patents on Hydrogenation and Dehydrogenation. Universal Oil Products Co. E.P. 483,417, 20.4.38. Conversion of aliphatic into alicyclic hydrocarbons, especially aromatic hydrocarbons, by dehydrogenation at 400–700° C. and under an absolute pressure of 0·25–7·0 atmospheres, using a solid granular catalyst comprising a major

portion of MgO, Al_2O_3, bauxite, Montmorillonite clays, kieselguhr, silica, etc., supported by a minor portion by weight of oxides Ti, Zr, Ce, Hf and Th.

E. Berl. E.P. 490,662, 18.8.38. Hydrogenation of carbonaceous substances in the presence of alkyl or aryl derivatives of naphthalene which form hydrogenated naphthalene compounds under reaction conditions.

H. D. Elkington. E.P. 491,312, 29.8.38. Production of low-boiling oils by passing higher-boiling oils in vapour form, together with steam, water gas, or other gases containing H_2 and O_2, at 350° C. and up to 200 atmospheres pressure over mixed catalysts. The latter contain at least one oxidising constituent comprising Mg, Ca or Zn, or oxides of phosphates of these metals, or of Fe—and at least one hydrogenating constituent, Al, Sn, W, V, Mo, Fe, Co, or sulphides of these metals or of Zn, and C as a catalyst activator.

Institution of Gas Engineers and F. J. Dent. E.P. 491,453, 2.9.38. Production of hydrocarbon gases by hydrogenation of solid residues from coal carbonization. The hydrogenation is carried out at 500–800° C. and at pressures above 5 atmospheres.

A. Mironescu and J. Niculescu. E.P. 491,992, 13.9.38. Production of anti-knock benzines and aromatics in three stages: (1) by treating vapours of paraffins boiling between 150–350° C. at temperatures of 480–520° C. to convert them into olefines, (2) conversion of olefines at 600–620° C. into *cyclo*-olefines (partial dehydrogenation of naphthenes occurs in this reaction and commencement of dehydrogenation of *cyclo*-paraffins with the formation of *cyclo*-olefines), (3) conversion of *cyclo*-olefines into aromatics at 720–780° C., during which the dehydrogenation of the naphthenes is completed.

H. E. Potts. E.P. 492,107, 15.9.38. Destructive hydrogenation of carbonaceous substances in which the initial substances are refined by hydrogenation in the presence of catalysts or carriers consisting of Al, C and Si, or their compounds, and then hydrogenating the products under pressure in a second stage using similar catalysts.

F. Fischer and H. Koch. U.S.P. 2,128,994, 6.9.38. Production of knock-proof benzine and lubricating oil by passing water gas at 200° C. and at atmospheric pressure in contact with a hydrogenation catalyst, and distilling the reaction product up to 125° C. The distillate is separated, and the distillation is continued up to 250° C. and the second distillate is heated to 120° C., after separation of paraffinic residue, under stirring in the presence of a polymerization catalyst. The oil layer obtained is purified and distilled at 250° C. at ordinary pressure, and the distillation continued to 200° C. under high vacuum for the recovery of a third distillate and residue, which is adapted for use in lubricating oil, and the third distillate and the paraffinic residue are distilled to recover knock-proof benzine.

C. Krausch and M. Pier. U.S.P. 2,132,855, 11.10.38. Hydrogenation of carbonaceous substances at 300–700° C. and under 1–20 atmospheres pressure in the presence of WS. W. S. E. C.

Polymerisation.

1409. Midget Polymerization Plants. A. L. Foster. *Nat. Petrol. News*, 10.8.38, **30** (32), R. 371.—Processing only 250,000 ft.^{3} cracked distillate stabilizer "tops" per day, the plant described yields 2600–2800 gals. 83–85 octane-number polymerized gasoline per day. Using direct labour, the plant cost less than $10,000 and the capital cost was recovered in 36 days. Phosphoric acid catalyst is used, and since the octane number of the cracked product may be now reduced in proportion with the amount of high-octane-number polymer available, the output of the cracking plant has been increased. The total output of the refinery has been increased by some 7%. H. G.

1410. Patents on Polymerization. Anglo-Iranian Oil Co., S. F. Birch and A. E. Dunstan. E.P. 472,463, 20.9.37. Production of motor spirit from olefines especially from *iso*butylene by treatment in an absorption stage carried out in the liquid phase with 50–65% concentrated H_2SO_4 at temperatures not above 40° C. in an apparatus

of the Holley–Mott type. The treatment is continued until the specific gravity is reduced to 1·2 or 1·10. The resulting acid liquor is separated and polymerized to obtain a crude mixture of di- and tri-*iso*butylenes. After removing the acid, the mixture is distilled to obtain the refined spirit.

British Celanese, Ltd. E.P. 487,652, 23.6.38. Lubricating compositions containing polymers produced from ethylene oxide which has been left in contact with fuller's earth.

Universal Oil Products Co. E.P. 492,567, 22.9.38. Conversion of butanes into gasoline in two stages: first pyrolysis and then polymerization.

Universal Oil Products Co. E.P. 492,727, 26.9.38. Conversion of olefines into hydrocarbons containing a large number of C atoms and more saturated by concurrent polymerization and hydrogenation, the polymerization catalyst being $AlCl_3$, $ZnCl_2$, $MgCl_2$, H_2SO_4, H_3PO_4, or BF_3, and the hydrogenation catalyst being oxides and sulphides of metals in the left-hand column of Group 6 of the periodic system.

Universal Oil Products Co. E.P. 492,728, 26.9.38. Processes described in E.P. 492,727, in which the polymerization catalyst is a solid phosphoric acid and a solid adsorbent, and the hydrogenation catalysts are oxides and sulphides of Cr, Mo, W, Ur.

W. H. Carmody. U.S.P. 2,128,985, 6.9.38. Production of hydrogenated heavy oil comprising lower polymers of coumarone and indene from crude solvent naphtha.

H. V. Atwell. U.S.P. 2,130,662, 20.9.38. Production of motor spirit from cracked products by cracking and separately fractionating them into a gasoline fraction including substantially all normal butane, a fraction containing H_2 and CH_4, and an intermediate fraction containing *iso*butane. The latter is polymerized using a catalyst, and the heavy polymers from this are returned to the cracking operation, and the lighter products including *iso*- and normal butanes and gasoline are returned to the fractionating step.

B. E. Roetheli and E. E. Stahly. U.S.P. 2,131,191, 27.9.38. Dispersion of olefines in the acid polymerization of *iso*- and normal olefines into motor spirit.

W. S. E. C.

Refining and Refining Plant.

1411. Solvent Refining of Lubricating Oils. E. R. Smoley, A. H. Schutte and H. R. Davis. *Oil Gas J.*, 10.11.1938, **37** (26), 37.—Data are given on the furfural extraction of various distillates and on the benzol ketone dewaxing of Pennsylvanian stocks. Reference is made to the Coubrough vacuum distillation process for the deasphaltizing and de-resination of Pennsylvanian crude. A list is also given of the location, operating ownership and charging capacity of the lubricating-oil solvent-extraction and dewaxing plants erected throughout the world. Data on the physical properties of the solvents employed are included.

Furfural refining is now used in installations having a total capacity of 26,500 brl. per day (32% of the world's total solvent extraction plants). A graph is given of the cost of plants of different capacities, using average solvent ratios, varying from about $175,000 for a 400-brl./day throughput to $490,000 for a 3700-brl./day throughput. Operating costs vary from 9 c. to 12 c. per brl. Data are given on the properties of charging stocks, yields and properties of raffinates and operating data when extracting Coalinga, Poso, Kettleman and Ventura distillates.

The Coubrough process employs a close-cut gas oil or kerosine which is blended with the oil and vacuum distilled, the asphaltic and resinous material being concentrated in the bottoms to a greater extent than with normal processes. The presence of diluent lowers the distillation temperature and prevents skin cracking in the heater tubes. Pennsylvanian crude may be distilled by this process to a 1·6% bottoms having a carbon residue of 9·95%, the distillates requiring far less clay than usual for finishing treatment.

The benzol-ketone dewaxing process is used in plants with a total capacity of 31,250 brl./day (63% of the total). The solvent used is a blend of acetone or methyl

ethyl ketone (the wax anti-solvent), benzol (to improve the solubility of the wax free oil) and toluol (to lower the freezing-point of the benzol in the mixture to below the filtration temperature).

The solvents are thermally and chemically stable and easily recovered. The cold test of the dewaxed oil is closely in line with the filtration temperature, whilst the results obtained are independent of the chilling rate. Filtration takes place without the use of filter acids or crystal modifiers. The success of the process is shown in the considerably higher yield of scale wax in the slack wax as compared with that of conventional processes.

Installation costs vary from $260,000 for a 400-brl./day unit to $1,040,000 for a 3950-brl./day unit, whilst operating costs are about 21 c. per brl. for wax distillate and 27 c. per brl. for cylinder stocks. C. L. G.

1412. Recent Progress in the Chemical and Physical Refining of Petroleum Products. Part 2. Refining of Gasoline. B. Kwal. *Petrol. Engr*, August, 1938, **9** (12), 66.—A discussion is presented of recent improvements in methods of sweetening and of treatment of cracked gasolines and pressure distillate, particular attention being paid to the factors affecting doctor-treatment and acid-treatment of cracked products.

Berger's improvements in the economics of doctor-treatment are based on the reduction of carry-over by a system of traps and settling-tanks which recover the lead sulphide and improve the condition of the waste water, and the use of centrifuges to separate the gasoline from the black strap, thus avoiding loss of gasoline in blowing. Traps are used to collect both the light and heavy black-strap emulsions.

Albright (*Refiner*, 1936, 124 and 318) describes the reduction of doctor-treatment costs from 6 cents to 2 cents per brl. by using alloy cast iron outside mixing nozzles instead of spiders and by increasing the gravity of the doctor solution from 16 Bé to 30 Bé. The treatment described consists of doctor-treating stabilized straight-run plus cracked gasoline in a continuous plant, followed by inhibiting the sweetened gasoline. Overall treating costs are given as 5 cents per brl.

Bottomley recommends the use of NaOCl for the sweetening of natural gas free from H_2S, all straight-run distillates relatively free from olefins and aromatics and some refinery recovery gasolines. Na_2CO_3 is cheaper than NaOH as a medium for the preparation of the reagent. $Ca(OCl)_2$ is cheap and satisfactory, but tends to form emulsions, whilst bleaching-powder in the form of a slurry or in a solution may also be used.

Schulze and Chaney (U.S.P. 2,028,998) propose removing any alkyl sulphur chlorides in hypochlorite-treated gasoline by conversion into disulphides using a solution of KOH and KCN.

Schulze and Buel (*Oil Gas J.*, 17.10.35) propose sweetening with $CuCl_2$, which does not remove natural gum inhibitors or form emulsions.

Other proposed desulphurizing methods are: Crosby and Carney (U.S.P. 2,030,245)—aqueous lime suspension; Wattson (U.S.P. 2,064,999)—heat treatment with lime; Retailleau and Wyman (Canada P. 355,082)—vapour phase treatment with iron oxide; and Malishev—CO using molybdenum sulphide as catalyst.

The H_2SO_4 treatment of cracked products has been studied by Morrell and Egloff, Walton (*Refiner*, 1936, 94 and 160), Sager (*J. Instn Petrol. Tech.*, 1936, 609) and Howes and Whittaker (*Refiner*, 1936, 363). The importance of a maximum treating temperature, the strength of the acid and the efficiency of mixing, contact time and type of settler, are stressed. The modern continuous treater economizes in time and chemicals and evaporation losses if air-blowing is substituted by the use of a closed system under pressure.

Bart, Gerward and Bajdakowa (*Now. Neft.*, 1936 (10), 7) propose the use of solid $ZnCl_2$, whilst Lachman (U.S.PP. 2,035,607 and 2,035,610), and Egloff (U.S.P. 2,060,291) prefer an aqueous solution of $ZnCl_2$, which is heated with the gasoline or cracked distillate under pressure, the product evaporating on releasing the pressure. Alternatively the gasoline may be mixed with air and passed through a suspension of ZnO in an aqueous $ZnCl_2$ solution.

Vapour-phase treatment of refined gasolines is covered by the Gray process using silicate adsorbents, and the Strattford using a slurry of fine clay in naphtha. In the Osterstrom process the cracked gasoline is treated at high pressure to maintain it in the liquid phase during polymerization of the di-olefines.

Brazhnikoff (*Neft.*, 1936, 21) proposes the vapour phase use of clay from Zikeev, Russia, whilst Glucman (*Azerb. Neft. Khoz.*, **12**, 60) prefers using the Russian clay gumbrin with gasoline in the liquid phase. Solvent extraction refining is being extended, Strattford (U.S.P. 2,024,117) proposing furfural-water and Hassard (Can. P. 356,562) methanol containing picric acid. C. L. G.

1413. Automobile Design Governs Modern Refinery Methods. W. W. Scheumann. *Oil Gas J.*, 3.11.38, **37** (25), 42.—The trends of improvement in automobile-engine design during the past ten years are reviewed, and the steps taken by refiners to meet the increasingly exacting demands are discussed. Diagrams are given showing: (1) the decrease in engine weight per max. B.H.P. between 1928 and 1938 for two typical popular-priced American cars; (2) the increase in average maximum B.H.P.; (3) and (4) the corresponding increases in engine speeds and compression ratios; and (5) the increase in the average brake mean effective pressure. A further important factor in the improved performance power and efficiency is the improved smoothness of running imparted by the increase in the number of cylinders in modern cars. The relative proportions of cars of different numbers of cylinders for the years 1927–1937 are tabulated. This also has a significance to the refiner in the effect of the fuel requirements on the increased difficulty in securing a uniform fuel mixture. The increased average octane ratings of fuels from 1927 to 1938 (estimated prior to 1931) is shown, but it is emphasized that correlation with car performance is still incomplete and owing to variable personal, fuel, engine and operating factors, it is doubtful if a precise index will ever be devised.

Methods used for increasing the octane rating of fuels include: (1) addition of tetraethyl lead, and (2) production of special gasolines. It is estimated that 75% of all gasolines now contain lead. Its use has also involved a study of the susceptibility of the gasoline for lead addition—viz., the effect of disulphides on lead response. Processes used or being evolved for improving the anti-knock value of gasolines include cracking, reforming, polymerization, alkylation of *iso*-paraffins and olefins, isomerization of straight-chain paraffins to either *iso*-paraffins or cyclic hydrocarbons, combinations of hydrogenation or dehydrogenation with alkylation or polymerization, and the production of synthetic hydrocarbons.

The increase in the volatility of average motor fuels is also illustrated, this being a result, not only of automotive design, but also of the increased production and recovery of butanes, etc. The effect has been to improve the uniformity of distribution, giving better anti-knock performance and economy. From 1931 to 1934 average intake manifold intake temperatures were reduced as a result 30° F., this being equivalent to an increase of about 2 octane numbers. Further increase is limited by vapour-lock difficulties, which depend on the vapour pressure of the fuel, the amount of heat radiated to the gasoline feed lines and their vapour handling capacity. C. L. G.

1414. Dehydration and Refrigeration for Natural Gasoline Recovery. D. W. Wilson. *Oil Gas J.*, 29.9.38, **37** (20), 48.—A description is given of a plant using the new recovery system for manufacturing natural gasoline by a combination of refrigeration and substantially complete dehydration of the gases. The plant is situated in Benavides, Texas, about 75 miles from Corpus Christi, and has been in operation for 6 months. The installation was designed to handle 6 million cu. ft. per day of wet gas containing 2·5 gals. per 1000 cu. ft. of 26 lb. R.V.P. natural gasoline. Gas enters the plant at atmospheric pressure, is passed through a scrubber to remove entrained liquid and is then compressed to a pressure of 50–60 lb. per sq. in. gauge. It is then cooled in exchangers to 40° F. and the condensed heavy hydrocarbons and water are separated in a suitable vessel. The gas then passes through one of two parallel driers, where it is freed from water to such an extent that no condensation of liquid water nor any solid formation occurs at temperatures as low as − 50° F. The water-free gas is then cooled to − 35° F. in an exchanger in which propane evaporates at practically atmospheric pressure. The resulting mixture of liquid hydrocarbons and gases is separated in a drum, the cold vapours being used to cool the feed gas. The cold liquid is pumped through a heat-exchanger cooling the liquid propane, and is mixed with the previously condensed heavy hydrocarbons, the

mixture being heat exchanged against finished gasoline from the bottom of the stabilizer. The liquid then passes to the 20-tray stabilizer operated at 175 lb. pressure and in conventional fashion. The driers are filled with granular material having a high absorptive capacity for water and operate alternately for periods of 24 hrs. Water removal is effected by passing through the drier residue gas heated to a temperature of 325–350° F. long enough to remove the water, and subsequently continuing to pass unheated gas until the drier is cooled. The whole operation occupies about 6 to 8 hrs. The refrigeration cycle and the auxiliary plant are described, and the whole operation is illustrated by a flow-sheet and by tables showing operating temperatures and pressures. Typical analyses, showing composition of feed gas, tail gas, stabilizer gas and of stabilized gasoline of 18·4 lb. R.V.P. produced, are given.

The analyses indicate 100% recovery of *iso*pentane and heavier and complete absence of propane in the stabilized gasoline. The plant has continuously processed 6½ million cu. ft. per day of gas producing 15,000 gals. per day of 18·4 lb. R.V.P. gasoline. The plant is extremely flexible, is operated by two men per shift and is simple to operate and control. The advantages of combining a thermal polymerization unit with such a recovery plant are outlined. R. A. E.

1415. Principal Factors of Absorber Design. R. H. Turner. *Petrol. Engr*, Sept. 1938, **9** (13), 51.—A brief critical description of the more important types of absorbers in gasoline plants is given, followed by a discussion of the factors in the design of modern-type bubble-cap columns which affect the absorption efficiency.

Filled columns, the first type in use, suffered from the disadvantage of inadequate distribution of the liquid due to channelling, whilst grid absorbers (wooden lattice work) were short-lived. Raschig rings reduced the tendency to channel, and spiral tiles improved the contacting owing to the whirling motion imparted. The type now in general use is the plate column, the simplest of which is the perforated plate type in which the ascending vapour prevents the oil from descending through the perforations. These, however, are easily blocked by foreign matter, whilst the velocity of the gases is extremely critical. The addition of permanent liquid seals on each plate with caps over the perforation considerably improved the intimacy of contact, the efficiency being further improved by cutting slots in the bubble caps, resulting in a larger contact surface between the liquid and vapour.

The efficiency of columns depends not only on the intimacy of contact, but also on the time of contact. If the latter is increased by increasing the depth of liquid on the plate, the bubble of vapour tends to rise through the liquid unchanged, owing to the slow rate of diffusion of the vapour. The bubbles should therefore be deformed as much as possible by violently forcing them through the slots or holes in the bubble-cap into the liquid. Placing the bubble-caps close together results in collision of bubbles from adjacent caps, whilst violent agitation of the liquid on the plate enables drops to be carried by the vapour into the vapour space, where equilibrium is more easily attained.

Increasing the vapour velocity, however, only increases the efficiency to a certain maximum, after which the vapour tends to carry the liquid from one tray to that above. The spacing of the plates controls the vapour velocity and restricts it to such a figure as to give ample time of contact between liquid and vapour consistent with a depth of liquid being maintained on the plate. The depth of liquid on the plates and the velocity of vapour through the column depend on the height of the caps and the distance between them. The pressure drop between any two plates of a column is a function of the depth of the liquid on the plates, the velocity of the vapour through the slots and the friction of the vapour passing through the slots and the liquid. The velocity head of the vapour V (in ft./sec.) may be calculated from the expression $V = C\sqrt{2gh}$, where C is a constant for the type of cap (=0·26–0·33), g is 32·2 ft./sec.², and h the static head plus pressure loss due to friction. With normal velocities, friction loss can be disregarded. Therefore, since the total pressure is the sum of the pressure due to the static head of the liquid plus the velocity head of the vapour, the maximum allowable velocity or, conversely, the pressure drop through any tower, can be calculated if the necessary factors are known.

C. L. G.

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1416. Non-electrical Regulating Devices in the Oil Industry. E. Sander. *Oel u. Kohle*, 1938, **14**, 595.—An illustrated account of automatic devices in common use in the oil industry for controlling pressure, temperature, quantity, level, etc.

Consideration is given only to those appliances which are operated by compressed air or by hydraulic means, and not by electrical relays. P. G. H.

1417. Large Tube Savings by Welding on 2-ft. End Sections. A. S. James. *Nat. Petrol. News*, 27.7.38, **30** (30), R. 347.—Tubes that have failed in service are sorted according to the type of the failure. Normally a failure occurs near the end of the tube. In such cases a length of 2 ft. is removed from the faulty end and another 2 ft. length is welded on. The short lengths may be cut from other tubes that have failed. The procedure is described in detail. A tube is never reconditioned more than once, except to provide the 2-ft. lengths, and reconditioned tubes are never used in the two bottom rows or in the radiant section of topping or cracking furnaces. The procedure has been adopted only with carbon steel tubes, but it is considered that alloy tubes could be as usefully recovered if the welding process were suitably modified. H. G.

1418. Heaters for Petroleum Refining. L. A. Mekler. *Nat. Petrol. News*, 27.7.38, **30** (30), R. 353 and 24.8.38, **30** (34), R. 396.—The author discusses comprehensively the development of oil heaters from the bottom-fired shell heater to the modern Equiflux heater, in which the tubes, which quite early replaced the shell, are heated on both sides, 80% of the heat being supplied by radiation. Heaters are classified into three groups: (*a*) those used for heating only with little or no decomposition; (*b*) heaters within which almost all the decomposition is required to take place; (*c*) heaters operating on plants where most of the decomposition takes place in external "reaction" units which are normally not externally heated. The requirements of these three classes are discussed mathematically, to illustrate the different demands as to heat requirements and rates of heat input. Many designs are illustrated diagrammatically. The Equiflux heater is described in some detail as a design applicable to a widely varying range of operating requirements of capacity, type of feed and time/temperature relationships. H. G.

1419. Lime Alone Needed for Treating Water at Toledo Refinery. M. G. Van Voorhis. *Nat. Petrol. News*, 24.8.38, **30** (34), R. 386.—The water supply has a permanent hardness of about 13 and a temporary hardness of 2. The latter is removed by the addition of lime. The water is then filtered through sand and gravel-beds. Scale formation is observed at times, and is removed by the cautious addition of sulphuric acid to the water. H. G.

1420. Efficiency of Water Treatment Extended by Organic Type Exchanger Bodies. P. G. Bird. *Nat. Petrol. News*, 24.8.38, **30** (34), R. 390.—The newer organic exchanger bodies, prepared from lignite, the condensation products of phenol and aldehydes and the sulphonation products of wood, coal, etc., may be used, in conjunction with the base-exchange zeolites, for the complete removal of both anions and cations from feed-water supplies. Silica is not removed. CO_2 is removed by aeration of the treated water. Soluble organic material may impart both taste and odour to the water. The use, scope and regeneration of the organic bodies are discussed. H. G.

1421. Patents on Refinery Plant. Eastman Kodak Co. E.P. 487,697, 24.6.38. Improved high-vacuum distillation process. W. S. E. C.

See also Abstract No. 1397.

Chemistry and Physics of Petroleum.

1422. The Chemical Nature of Cracking Residues. N. A. Orlov, K. F. Protyanova and V. P. Flegontov. *Refiner*, Aug. 1938, **17** (8), 399.—A detailed account of the analysis of the heavier fractions of the tar produced in a two-column, horizontal

Pintsch retort is presented. Styrene, pseudocumene and mesitylene were isolated in the 150–200° C. fraction, and the isomeric methylnaphthalenes, phenanthrene and anthracene from the 200–300° C. fraction. H. G.

1423. Evaporation and Detonation Properties of Motor Gasoline. O. Herstad. *Oel u. Kohle*, 1938, **14**, 579, 657, 677.—A benzine was separated into a distillate and a residue by distillation to 128° C. Each portion was then separated into an extract and a raffinate by a special solvent extraction. It was found that the "siedekennziffers" of extract and raffinate were practically the same in the case of distillate and residue, respectively. The octane number of every fraction was determined by the "transformation" method previously described by the author (*Oel u. Kohle*, 1936, **12**, 1014; 1111; and 1937, **13**, 208; 1007), and was in good agreement with the octane number as obtained in the I.G. testing engine, except in the case of the raffinate ex residue (octane number: 43 (I.G.), 54 ("transformation")). Air pressure and humidity were blamed for such small differences as existed between corresponding results for the other fractions.

The S.I.T. of the above fractions were determined by a modification of the author's "transformation" technique, and gave values ranging from 557° C. to 620° C. The octane number rose regularly with S.I.T.

Relation between Quantity of Sample and "Transformation" Behaviour.—1 c.c. is ordinarily used for the test. The behaviour of smaller quantities (as are concerned in an engine) was studied by using methyl*cyclo*hexane. The usual curve was first determined by measuring the time (t) (secs.) required to evaporate 1 c.c. at a series of temperatures (T). At first, t decreased with rise in T, then suddenly increased when T reached "transformation" temperature. Thereafter t again decreased, the "transformation" curve being followed. The experiment was repeated with different quantities of sample. The times to reach certain fixed, critical points on the transformation curve were then plotted against quantity of sample. If log (quantity of sample) was plotted against log (seconds), a straight line resulted. This relationship was valid for evaporation both above and below the "transformation" temperature, but the lines had different slopes. It was found that $y = cx^m$, where y = size of sample (mgms.), x = evaporation time (secs.), and m, c = constants.

This was valid for all of a number of other liquids (pure compounds and gasoline or diesel fuels).

In a four-stroke engine (4500 R.P.M.) the time available for evaporation is estimated at 0·01 sec. Accordingly, in the "transformed" state the droplets of fuel must be 25,000 times smaller than they need be in the "non-transformed" state, in order to evaporate in 0·01 sec. Therefore, for maximum combustion efficiency the proportion of "changed" droplets should be at a minimum.

The evaporation of very small droplets was studied microscopically. In the case of pure liquids (alcohols, CCl_4 etc.) the evaporation time decreased in straight line proportionality as droplets *increased* in size.

Mixed liquids (hydrocarbon fractions ex I.G.) evaporated more rapidly than was expected when the smallest drops were examined. P. G. H.

1424. Urea-Formaldehyde Film-Forming Compositions. T. S. Hodgins and A. G. Hovey. *Industr. Engng Chem.*, 1938, **30**, 1021.—The general reactions of urea and formaldehyde are reviewed and extended to include the special reactions taking place in the presence of mono- and poly-hydric alcohols. The mechanism of the polymerization which follows the condensation reaction is discussed, and the properties and uses of urea-formaldehyde alkyl condensation products are given.

J. W. H.

1425. Viscosity Function. E. P. Irany. *J. Amer. chem. Soc.*, 1938, **60**, 2106–2115.—The author points out that as yet the relations of viscosity to temperature, pressure, dilution, etc., are still obscure, and that the various empirical rules so far proposed are without general validity or physical significance. By graphical means, however, the author shows that it is possible to represent the viscosity of a mixture when expressed in centipoises against vol.-%, as a straight line, provided that the

mixture is ideal. It is found that all other ideal mixtures will give a straight line using the same co-ordinates. The unit of quantity with reference to viscosity must, however, be volume.

Non-ideal mixtures—*i.e.* those in which association (or dissociation) occur—give graphs which in general indicate the molal concentration at which the association occurs.

Similarly, it is possible to obtain a general viscosity scale which will give a straight-line plot when viscosity is plotted against temperature for ideal substances. It is found that this scale is identical with that previously obtained for viscosity against dilution.

The paper contains an impressive list of substances which give straight-line plots on this system.

The author shows that it is possible to make certain observations regarding the accuracy of critical points for liquids, using the viscosity graphs developed. The effect of pressure on viscosity can also be represented linearly, but in this case a different viscosity function is required, although the viscosity-pressure diagrams of ideal substances are again linear when plotted on the viscosity-pressure chart. By means of the latter it has been possible to calculate the internal or cohesional pressure at which the viscosity of a liquid is zero, since for any homologous series the pressure-viscosity lines meet at a point. This internal pressure varies for different series.

For associated liquids, curved plots are obtained, becoming linear at higher pressures. The projections of the linear portions of the curves again meet at a point, and give the internal pressure. W. E. J. B.

1426. Viscosity of Aniline between 20° and 100° C. L. A. Steiner. *Industr. Engng Chem. Anal.*, 1938, **10** (10), 582–584.—The usual fluid employed in calibrating viscometers is water, but since it has a very low viscosity, the author points out that it is not suitable for the calibration of instruments designed to determine the viscosity of lubricating oils. At the same time, there are no chemically pure stable liquids with viscosities of the latter order; for this reason the author proposes the use of aniline as a calibration liquid.

The viscosity of aniline is about four times that of water, and a capillary calibrated with this liquid can be conveniently used on a light oil, which in turn can be used as a standard for work on a viscous oil. Using Steiner falling body viscometers, the author has determined the absolute viscosity of aniline at 5° intervals over the range 20–100° C., with an estimated accuracy of $\pm$ 0·20%.

Advantages claimed for aniline over water as a calibrating liquid are: its surface tension is only slightly greater than that of lubricating oil; it can be used for calibration at any temperature from 20° to 100° C., whereas water can be used for this purpose only at 20° C. This latter fact is of importance, as viscometer constants, especially in the case of metal viscometers, may vary considerably with temperature. T. T. D.

1427. Negative Temperature Coefficient in the Rate of Propane Oxidation. R. N. Pease. *J. Amer. chem. Soc.*, 1938, **60** (9), 2244–2246.—A further study of the negative temperature coefficient in the rate of oxidation of propane has been carried out. It is shown that the rate passes through a minimum at 360–380° (100 mm. of each gas). At low temperatures the steady-state rate is independent of oxygen concentration (uncoated reaction bulb), whereas at higher temperatures it depends on the concentrations of both gases, the powers being between one and two.

It is suggested that a low-temperature branched-chain reaction is suppressed in the transition region and gives place to an unbranched chain. W. E. J. B.

1428. Physical Chemical Properties of *cis*- and *trans*-Decahydronaphthalene. W. F. Seyer and R. D. Walker. *J. Amer. chem. Soc.*, 1938, **60** (9), 2125–2128.—Commercial decalin was fractionated under reduced pressure to give pure forms of *cis*- and *trans*-decahydronaphthalene.

Physical data obtained are shown below :—

	d_4^{20}	n_D^{20}.	F.p. ° C.	B.p. (760 mm.). ° C.
cis-form . .	0·8963	1·48113	43·26 ± 0·04	194·6
trans-form . .	0·8699	1·46968	31·47 ± 0·04	185·5

The freezing points are higher than those previously recorded in the literature. Nine mixtures of the two forms were prepared, and the densities and refractive indices measured. Both these properties were linear functions of the composition of the mixture. W. E. J. B.

1429. Physical Properties and Chemical Constitution. Part III. *cyclo*Pentane, *cyclo*Hexane, *cyclo*Heptane and some Derivatives. The Multiplanar Structure of the Methyl*cyclo*hexane Ring. A. I. Vogel. *J. chem. Soc.*, 1938, 1323–1338.—The surface tensions and densities over a range of temperatures, and the refractive indices for the *C*, *D*, *F*, and *G* lines at 20° have been measured for pure *cyclo*pentane, methyl*cyclo*pentane, *cyclo*hexane, methyl*cyclo*hexane, *cyclo*heptane and the related ketones, alcohols and unsaturated hydrocarbons, together with a number of methylene compounds. The parachors, molecular refractivities, dispersions and molecular refraction coefficients have been evaluated. Several forms of methyl*cyclo*hexane have been isolated; this provides evidence for the multiplanar structure of the simple *cyclo*hexane ring. W. E. J. B.

1430. Refraction, Dispersion, and Related Properties of Pure Hydrocarbons. A. L. Ward and S. S. Kurtz, Jr. *Industr. Engng Chem. Anal.*, 1938, **10** (10), 559–576.—Comprehensive tables are given of b. pt. at 760 mm., density (d_4^{20}), specific refractivity (n_D^{20}), refractive intercept at 20° C. and dispersion (*F*–*C*) of hydrocarbons boiling between 10° C. and 200° C. at atmospheric pressure.

From this data the authors have prepared tables of the average properties of cuts of specified boiling ranges (seven cuts covering the range 10–200° C.). Average curves are also given of density against b. pt., refractive intercept against b. pt., specific dispersion against b. pt., coefficient of cubical expansion against b. pt. and change in density per degree change in temperature against density, for the main classes of hydrocarbons (paraffins, olefines, naphthenes and aromatics).

From the mass of data collected, the relationship between refractive index and density of isomers is examined, and shown to be linear. A table is given of the quantitative effect of substitution on the density of paraffins, and it is shown that substitution which tends to increase the symmetry of the molecule causes an increase in both density and refractive index. The authors make use of the relationships which they show exist between the various properties of hydrocarbons and their structures in checking dubious data and estimating undetermined values. 12 Figures, 15 tables, 177 references. T. T. D.

1431. Action of Filter Aids. P. C. Carman. *Industr. Engng Chem.*, 1938, **30** (10), 1163.—The behaviour of filter aids has been studied experimentally by determining the specific permeability of typical slurries for various proportions of filter aid and at different pressures. For determination of filtration rates, a modified form of the equation given by Walker, Lewis and McAdams was used, namely

$$\frac{dV}{d\theta} = \frac{PA^2}{\eta(r_1 cV + \rho A)}$$

solve V = c.c. of filtrate in time θ (seconds),
P = pressure difference across cake and cloth, gm./sq. cm.
A = area of filtering surface, sq. cm.
c = dry weight of cake (grams) deposited by 1 c.c. of filtrate.
ρ = resistance of cloth.
η = viscosity of filtrate, poises.
r_1 = specific resistance, in the sense of being the resistance of unit dry weight of cake solids per unit area.

If filtration is carried out at constant pressure, r_1 and ρ are both constant, so that the time discharge curve is given by

$$\theta = \frac{\eta r_1 c}{2PA^2} V^2 + \frac{\eta \rho}{PA} V$$

which is a parabola.

The main conclusions reached in this work were :—

(1) The action of a filter aid such as kieselguhr is mainly mechanical—*i.e.*, its function is to provide a rigid filter cake structure of high porosity. For kieselguhr added to suspensions of finely ground ferric oxide, this conception is sufficient to explain experimental results.

(2) When kieselguhr is added to suspensions which are partly colloidal, it proves to have a greater efficiency than is to be expected from its action in forming a porous cake. An explanation is given of the electronic theory.

(3) Small additions of metallic hydroxides to kieselguhr actually increase the permeability of the latter.

(4) The method of calculating and plotting data in the present paper shows that (*a*) filter aids are effective only if correctly proportioned in the cake and (*b*) they are best applied to highly compressible cakes, since the improvement in rigidity of the cake enables high filtration pressures to be employed.

H. E. T.

1432. Inflammation Limits and their Practical Application in Hazardous Industrial Operations. G. W. Jones. *Chem. Rev.*, 1938, **22**, 1.—The factors affecting the limits of inflammability are discussed, and the upper and lower limits of inflammability are given for a large number of different liquids and gases.

Attempts to correlate these limits with calorific value, or the amount of oxygen required for the complete combustion of 1 mole of the vapour, are shown to be quite unsatisfactory when applied generally, but these properties may be used in predicting the inflammability limits of new compounds which are chemically similar to compounds of known inflammation limits.

The methods for calculating the inflammability limits of mixed gases from a knowledge of their individual limits are discussed. Practical means of eliminating or minimizing explosions in industrial operations are reviewed. J. W. H.

Analysis and Testing.

1433. Value of Ageing Tests in Assessing Stability of Mineral Oils. M. Marder and V. Tolkmitt. *Oel u. Kohle*, 1938, **14**, 615, 635.—Data previously reported by Noack (*Angew. Chem.*, Beiheft **28**, 1937, 4) on eight lubricating oils, each aged by six different standard tests, are studied in an attempt to decide the real order of merit w.r.t. tendency to change by oxidation. For a given method of test the difference between the highest and lowest values of the specific method of reporting (per cent. asphalt, viscosity increase, acid number, etc.) was taken to represent an ageing rating of eight. The other six oils have intermediate, proportional values for each method of test. Only one or two of the oils had approximately the same rating by all methods of test. The test, the conditions of which approached nearest to practice, should be chosen as a means of rating, but it is very difficult to decide in the case of motor oils what conditions to adopt as standard, owing to the variability of temperature in practice. Authors therefore studied effect of temperature on relative order of oxidizability, with a view to predicting behaviour of oils at other (standard) temperatures.

Ten oils of different origins and methods of refining were oxidized in apparatus described by Noack (*loc. cit.*) (65 gm. oil oxidized with air; oxidation measured by per cent. asphaltenes + resins adsorbed by active earth). Effect of period of oxidation (30, 60, 120 mins.), temperature (200°, 250°, and 275° C.), and air-rate were studied. The oils were then rated by the above method. At different temperatures of oxidation widely different ratings were obtained for the ten oils. Temperature coefficients of ageing also differed, and were apparently unrelated to analytical data of original oils (*d*, " pole-height," mol. wt.). It was concluded that asphaltene +

resin formation is influenced by other factors—*e.g.*, nature and extent of refining. Widely divergent ratings were also obtained with different periods of oxidation and different air-rates. By suitable choice of conditions, therefore, a series of oils could yield completely reversed order of merit. The coefficients of temperature, time, and air-rate w.r.t. stability vary from one oil to another.

The viscosity increases obtained by the various methods of ageing were not proportional to each other in the case of any one oil. In certain methods of oxidation a *reduction* in viscosity may occur, owing to formation of cracked products. The acid number and saponification values of oils after oxidation by different methods afforded a no more reliable means of assessing the relative order of oxidizability.

P. G. H.

1434. Testing of Asphaltic Bitumen Emulsions. H. Suida and O. Jekel. *Asph. u. Teer*, 1938, **38** (41), 700–703.—Determination of water content and recovery of bitumen for heating are carried out by distillation of 300–400 gm. of emulsion with 150 ml. of benzole in an apparatus consisting of a still fitted with delivery tube, for passing carbon dioxide through the bitumen solution to remove solvent when water estimation is complete, a graduated 250-ml. receiver similar to the normal receiver for water estimation and reflux condenser. It is claimed that water estimation is more accurate than the usual method, and that the properties of the recovered bitumen correspond more closely with the original than when other methods are used. Total emulsifier is determined by filtering the diluted benzol–bitumen solution, washing the paper with benzole and weighing, then extracting with warm aqueous alcohol, drying and re-weighing. The customary examination is made of the alcoholic extract. Investigations show that none of the methods for estimation of emulsifier are entirely satisfactory, but the authors' method is considered the best; this gives results which are low. A. O.

Motor Fuels.

1435. High-Octane Aircraft Fuels. J. Brynikowski. *Przem. Naft.*, 25.9.38, **18**, 499.—A comprehensive review of work carried out on the improvement of anti-knock properties of fuel for aircraft purposes.

The properties of aircraft fuels with very high octane numbers from 87 to 100, mainly those of *iso*-octane and *iso*-pentane and of the aromatic compounds (benzene, toluene, etc.) are reviewed. The paper also discusses the production of the above fuels on a technical scale. E. J. W.

1436. Fuels for Internal-Combustion Engines. G. Egloff, W. H. Hubner and P. M. Van Arsdell. *Chem. Rev.*, 1938, **22**, 175–280.—Fuels of any desired octane or cetane rating are available from many sources in ample quantities for years to come. The sources of fuels reviewed are petroleum, natural gas, coal, oil shale, plants and wood.

The modern processes for the preparation of straight-run and cracked fuels are described, and the quantities and quality of fuels available from these sources are given. Solvent extraction followed by selective cracking is shown to be a method of raising the average anti-knock rating of the present supply.

The high octane numbers of the lower members of the paraffins (methane of octane number = 125) makes natural gas an important source of fuel. Details are given of results obtained when running generating sets and transport vehicles on fuels of this type.

The preparation is reviewed of high-octane fuels from cracked gases by the various polymerization processes, or by the manufacture of certain alcohols, ethers and ketones. Reviews follow of the methods for the production of oil from coal—*i.e.*, high- and low-temperature carbonization, hydrogenation, and the Fischer–Tropsch process. The quantities produced by these various processes are detailed. Under the heading of motor fuels from plants and wood, the manufacture of alcohol by the fermentation process and the production of fuels by the direct gasification of wood are discussed. The article concludes with a review of compounds which may be added to improve the octane and cetane number of fuels. J. W. H.

1437. Molecular Structure of Hydrocarbons and Engine Knock. W. G. Lovell and J. M. Campbell. *Chem. Rev.*, 1938, **22**, 159.—In the case of the paraffins, lengthening of the straight chain makes the knock characteristics worse, centralizing the molecule without changing the number of carbon atoms, or the addition of methyl groups increases the anti-knock value; thus the knock depends on the length of the unbranched straight chain in the molecule.

The effect of lengthening the chain in the case of the straight-chain olefins is similar qualitatively and quantitatively to that observed in the paraffins. The greater the symmetry of the molecule with respect to the double bond, the greater the anti-knock value. The effect of branching is similar to that observed in the paraffins.

Ring formation to yield *cyclo*-paraffins and *cyclo*-olefins enhances the freedom from knock when compared with the corresponding straight-chain compound containing the same number of carbon atoms. The greater the number of carbon atoms in the ring, the lower the anti-knock value. The addition of alkyl groups to the molecule lowers the anti-knock value, the greater the number of carbon atoms in the alkyl group the greater this effect; but centralization of the molecule has the power of decreasing the effect of the increased number of carbon atoms—thus the order of greatest anti-knock value is *tert.*-alkyl, *sec.*-alkyl, *iso*-alkyl and *n*-alkyl.

The simple aromatic ring compounds possess greater anti-knock values than the corresponding naphthenes. The addition of side-chains with progressive lengthening to a benzene ring at first increases the freedom from knock, whilst further lengthening of the chain results in a decrease. Position isomerism is also an important factor.

The effect of lead tetraethyl in raising the critical compression ratio of hydrocarbons is closely related to their structure; generally speaking paraffins and naphthenes and saturated side-chain aromatics show a good response, whereas olefins and acetylenes give no response at all, whilst the response of unsaturated cyclics is negative. J. W. H.

1438. Knock Testing in the Laboratory and in Service. G. Edgar. *J. Soc. aut. Engrs*, 1938, **43** (3), 7–12, 17–19.—This paper discusses the problems involved in correlating road results and laboratory ratings of automobile fuels, and also deals with the problem as applied to the aeroplane.

The road-test method used at Uniontown in 1932 and 1934 and by other investigators since that time is discussed, together with the difficulties involved in arriving at average ratings of fuels.

Such factors as the different behaviour of a given fuel in several cars of the same make and model, and the differences in knocking characteristics of many fuels as compared with reference fuels, complicate the work of analysing data obtained. Although laboratory tests cannot predict the behaviour of a given fuel in a given car with any great accuracy, the large amount of work carried out on the whole subject has resulted in test methods giving a fair reflection of service performance.

There is much to be said for the development of two or more laboratory methods corresponding to extremes of mild and severe conditions, with proper allowance for volatility effects.

The problems involved in rating aircraft fuels are perhaps of more vital importance than those concerning the automobile, as abnormal burning of the fuel can so quickly lead to engine failure and possible disaster. The author thinks it probable that different test methods may be necessary for different octane-number ranges. Chemical tests may be necessary to eliminate certain types of fuel. It may prove to be desirable to develop two tests at varying "severity levels" to evaluate properly fuels of high sensitivity to conditions of test. C. H. S.

1439. The Economics of Knock Ratings of Otto-Cycle Engine Fuels. P. C. Keith, Jr., J. S. Carey and J. T. Ward. *Chem. Rev.*, 1938, **22** (1), 281.—Statistics are given for the consumption of various grades of fuel over a period of years, together with the average octane numbers. An analysis is made of the costs of refining treatments on fuel from various crudes, with the resulting price for a given octane number. The influence of lead tetra-ethyl is included.

The production of aviation fuels is fully examined and illustrated with typical specifications and comparisons between cost of fuel and saving in running-cost from improved performance.

The economics of high-octane blending agents is described, and mention is made of potential sources of supply.

The authors reach many important conclusions from their analysis. J. G. W.

1440. Knock Rating of Motor Fuels. H. W. Best. *Chem. Rev.*, 1938, **22** (1), 143.—An outline is given of the standard laboratory method of determining knock ratings, together with the methods used to determine the corresponding road ratings. The effects of running conditions and adjustments are discussed, from which it is shown how difficult it is to correlate laboratory procedure with average road behaviour when a large variety of fuel types must be considered.

The question of fuel "sensitivity" is examined and illustrated by the effect of changes in the running conditions of the C.F.R. engine. Factors affecting the laboratory knock ratings which could readily be changed in order to produce better correlation with average current service conditions are discussed.

Variables affecting the precision of ratings are also mentioned. J. G. W.

1441. Patents on Motor Spirit. N.V. de Bataafsche Petroleum Mij. E.P. 492,789, 27.9.38. Removing acid components from hydrocarbons or their derivatives—*e.g.*, mercaptans—using a saturated solution of alkaline hydroxide in aqueous ethylene glycol (not more than 75% of ethylene glycol), and then water-washing.

W. C. Ault and C. A. Hochwalt. U.S.P. 2,131,879, 4.10.38. Catalytically refining motor spirit using an acid-reacting compound of P below cracking temperature in the presence of water-vapour.

W. S. Gullette. U.S.P. 2,132,159, 4.10.38. Vapour-phase refining of motor spirit by refractionation.

M. P. Youker. U.S.P. 2,132,453, 11.10.38. Conversion of highly-volatile hydrocarbon constituents of natural gas into relatively less volatile hydrocarbon liquids.

N. E. Lemmon. U.S.P. 2,133,457, 18.10.38. Refining of petroleum oils to produce white medicinal oils.

K. Süsselbeck. U.S.P. 2,134,241, 25.10.38. Refining crude benzole, benzene and cracked benzene by heating under pressure, then reducing the pressure and passing the vapour so formed through a heated liquid refining agent—*e.g.*, phenols and homologues at temperatures above that of the b. pt. of the crude hydrocarbons.

H. B. Cooke. U.S.P. 2,134,325, 25.10.38. Conversion of normally gaseous hydrocarbons into liquid hydrocarbons. W. S. E. C.

See also Abstract Nos. 1406 and 1423.

Gas, Diesel and Fuel Oil.

1442. Petroleum Fuels for Small-Scale Industries. P. H. Herring and H. F. Jones. *Petrol. Times*, 3.9.38, 1025 (**40**), 307 and 10.9.38, 1026 (**40**), 339.—In the number and diversity of the smaller industrial applications of petroleum fuel the versatility of the latter is well illustrated. In a brief survey of these outlets the authors enumerate sundry industries in which fuel oil is being used with great success. These outlets include the heating of crucibles for metal casting, the heating of muffle furnaces for the heat treatment of metals and for the production of enamels and glazes, use on portable plants such as bitumen heaters and road heaters, and in bakeries and confectionery works for the heating of ovens and jam- and sugar-boilers. Fuel-oil burners are being successfully used for heating the stoves in the lacquer industry, and for singeing pig carcases in bacon factories. The self-contained portable heating unit has been made possible only by the use of fuel oil, and the efficiency and reliability of such units have reached a high order. H. G.

1443. Methods of Rating Diesel Fuels. P. H. Schweitzer. *Chem. Rev.*, 1938, **22** (1), 107.—The author summarizes the work of the various investigators who have contributed to the study of the ignition rating of diesel fuels.

Various methods of determining the ignition delay period are critically examined, and such matters as the choice of a suitable test engine and the development of testing technique are fully discussed. The effects of various engine operating conditions are mentioned, and the possibility of standardizing specified operating conditions for the C.F.R. engine is examined.

The author concludes by outlining the present technical and commercial status of diesel fuel testing. J. G. W.

1444. Patent on Kerosine. A. P. Hewlett. U.S.P. 2,133,452, 18.10.38. Refining of distillates having b. pts. at least as high as that of kerosine by agitation with 100% H_2SO_4 in the presence of boron fluoride, and separating the resulting sludge from the oil. W. S. E. C.

1445. Patent on Fuel Oil. G. W. Johnson. E.P. 493,084, 3.10.38. Diesel oils are improved by adding up to 5% of condensation products derived from high mol. wt. aliphatic hydrocarbons and oxygen-containing aromatic compounds. W. S. E. C.

Lubricants and Lubrication.

1446. Catalysts Accelerating the Ageing of Lubricating Oils in Engines. F. Chierer. *Przem. Naft.*, 10.9.38, **17**, 479.—In the lubrication systems of engines, particularly motor-car engines, two types of solid "mechanical" impurities are found: "external" impurities, mostly silica-alumina compounds from road-dust, and "internal" impurities in the form of iron filings and iron oxides produced by the friction of the moving parts against each other.

It seems that these impurities accelerate the ageing process of the oils by the formation of acidic products and asphaltic and coke-like precipitates.

To investigate the matter a series of oxidation experiments was carried out by the "DTD 109" method; ½% of dry sand and clay and identical amounts of iron filings, chemically pure iron, and iron oxides being added to the respective samples. It was found that iron filings had the greatest effect on the acceleration of the ageing of the oils. Chemically pure iron and road-dust followed next. The accelerating effect of oxides of iron was negligible. E. J. W.

1447. Lubricating Oils from Lignite. K. Bube. *Oel u. Kohle*, 1938, **14**, 499.—An account of wartime efforts to utilize the heavier lignite oils as lubricants. Oils were obtained which had relatively high setting point, $E_{s.p.} = 5°$ (approx.), and flash point 150° C. Dewaxing by cold pressing or by action of solvents enabled setting point to be lowered to about − 8° C. P. G. H.

1448. Petroleum in the Metal Working Industry. C. Chilvers. *Petrol. Times*, 10.9.38, 1026 (**40**), 345.—The article deals with the cutting and soluble oil used in metal turning. The function of a cutting oil is to reduce friction, and so to minimize the heat generated, to cool the cutting edge of the tool in order to avoid impairing the temper of the tool and to assist in clearing away the fragments of metal as they are turned off. The efficiency of a cutting oil is judged in terms of its ability to fulfil these demands. In addition, the oil should be economical in use, recoverable with its efficiency impaired to a minimum extent, be a good rust and corrosion preventative and should at least not impair the natural finish of the metal. Cutting oils usually consist of mineral oils of appropriate viscosity compounded with lard oil, and sometimes with such extreme-pressure dopes as sulphur, sulphur chloride or sulphurized fatty oils. Soluble oils are used mainly as cooling media, and consist of concentrated emulsions of mineral oil which are capable of dilution, with water, to any desired degree for use. When diluted they are normally "milk-white" fluids, but a few special products yield translucent suspensions on dilution. Their desirable properties are similar to those of a cutting oil. H. G.

1449. Additional Notes on the Analysis of Greases. H. Burstin and E. Katz. *Przem. Naft.*, 10.11.38, **21**, 591.—The standard testing method PN/P-233 is found to be somewhat unsatisfactory and inconvenient when only the determination of the solid

foreign matter is desired. Apart from the long time taken (three extractions have to be carried out to separate the oils from the soap, which in the particular instance is quite unnecessary), the results for the amounts of "solid foreign matter" in the grease are sometimes too high. This is partly due to occlusion of soap by particles of the "solid foreign matter," and partly to small amounts of grease remaining unextracted in the folds of the folded filter.

The authors have developed a method for the determination of the "solid foreign matter" only. The method consists of a single extraction with an 80 : 20 mixture of benzene and methylated spirit. The results obtained have been proved by comparison with those obtained by a third method, consisting of filtering a hot solution of the grease in an 80 : 20 benzene–methylated spirit mixture and subsequent drying and weighing of the filter. The authors propose, therefore, to substitute the method PN/P-233 by a method of single extraction with a benzene–methylated spirit mixture in the case where only the determination of the "solid foreign matter" is required.

E. J. W.

1450. Patents on Lubricating Oil. Standard Oil Development Co. E.P. 491,962, 9.9.38. Refining lubricating oil in the liquid phase by subjecting the de-asphalted oil for 2½–4 hrs. to the action of air or inert gases containing 21% O_2 at 400–500° F. The reaction is carried out in the presence of copper naphthenate, manganese stearate or other heavy metal soap, and the oxidized oil is treated with 1–5% by volume of concentrated H_2SO_4 and then clay.

Texaco Development Co. and A. H. Stevens. E.P. 492,017, 13.9.38. Continuous dewaxing of hydrocarbon oils using a rotary filter.

A. C. Egerton. E.P. 492,516, 19.9.38. Method of preventing gum formation in oils which are subjected to an atmosphere containing oxides of N_2, by adding to the fuel before admission to the combustion chamber, 0·05–5% by weight, of alkyl or aryl derivatives of urea—*e.g.*, diphenylurea.

L. A. Clarke. U.S.P. 2,131,999, 4.10.38. Solvent refining of hydrocarbon oils using nitrodiphenyl.

E. C. Herthel. U.S.P. 2,132,108, 4.10.38. Dewaxing of hydrocarbon oils using valeric ethyl ester, propionic ethyl ester, and a major portion of a volatile hydrocarbon diluent of boiling range below that of the oil to be dewaxed.

M. R. Fenske and W. B. McCluer. U.S.P. 2,132,151, 4.10.38. Counter-current apparatus for solvent extraction operations.

L. A. Clarke. U.S.P. 2,132,350, 4.10.38. Solvent refining of hydrocarbon oils using resorcinol monoacetate.

E. C. Knowles and E. W. McNealy. U.S.P. 2,132,354, 4.10.38. Dewaxing of hydrocarbon oils by centrifuging, wherein the oil which contains either a naturally occurring or an added wax crystal modifying substance is mixed with a suitable solvent liquid and heated to an elevated temperature before chilling.

E. C. Knowles. U.S.P. 2,132,355, 4.10.38. Dewaxing of hydrocarbon oils using methyl ethyl ketone or *iso*propyl ether. The wax is removed from the mixture of solvent and oil by filtration at relatively low temperatures in the presence of an organic filter-aid material—*e.g.*, dioxane.

B. Y. McCarty. U.S.P. 2,132,359, 4.10.38. Selective solvent refining of hydrocarbon oil using furfural.

L. Hunyadi and I. Koch. U.S.P. 2,132,900, 11.10.38. Oil-distilling apparatus—*e.g.*, for reclaiming used oil.

P. D. Barton. U.S.P. 2,133,338, 18.10.38. Multi-stage dewaxing using an excess of solvent diluent in the first stage.

J. R. Miller. U.S.P. 2,133,359, 18.10.38. Apparatus for purifying lubricating oil.

B. Hopper and K. Kingman. U.S.P. 2,133,618, 18.10.38. Method of operating propane dewaxing systems.

A. W. Francis. U.S.P. 2,133,691, 18.10.38. Solvent refining of hydrocarbon oils at 100° C., using as solvent pyridine in which about 5% of lithium chloride is dissolved.

W. P. Gee. U.S.P. 2,134,331, 25.10.38. Separation of wax from mineral oils by filtration.

E. C. Knowles. U.S.P. 2,134,336–2,134,337, 25.10.38. Dewaxing of hydrocarbon oils in the presence of a wax crystal modifying substance.

W. S. E. C.

See also Abstract No. 1433.

Asphalt and Bitumen.

1451. Reports on the Use of Cement, Brick and Surfaces of Special Materials. Perm. Int. Assoc. Road Congr., Eighth Congress, The Hague 1938, *Papers* 1–20. (*The Numbers of the Papers are given below in bold type.*)—A number of the reports make reference to the use of bituminous material as expansion jointing and as bedding course and joint filler in brick and iron paving. **5.** In Belgium an expansion joint, consisting of cork impregnated with bitumen and wrapped in bituminous paper, is stated to be used in the lower part of the joint, and a mixture of 60% bitumen and 40% aluminium powder in the upper part. **6.** In Denmark a mixture of oxidized bitumen and 0·3 mm. cork is used in the lower part of the joint and a mixture of 40 penetration bitumen, ground limestone and 8% asbestos in the upper part. A filler which is claimed to be ductile and plastic, and less susceptible to temperature changes than asphaltic materials, consists of an organic binder and mineral base. **7.** Reference is made to practical tests, by the U.S. National Paving Brick Association, of a number of fillers over a period of two years, which resulted in the following materials being selected for more extensive trials: (1) Blend of 65% Mid-Continent base and 35% asphaltic base of 23–32 penetration and 101–110° C. softening point. (2) Same as (1), but containing 20–30% of mineral matter, and having a penetration of 17–26 and softening point 107–116° C. (3) Coal-tar pitch of 35–65 penetration and 60–75 softening point. (4) Mixture of 38–42% of plasticized sulphur and asphalt of 28–34 penetration and 65–75° C. softening point. **14.** In Japan impregnated felt is generally used as expansion jointing, but premoulded plates of asphalt, filler and "Susa" or mixtures of emulsion and sawdust have given good results. **16.** A mixture of blown bitumen with sawdust, slag wool, etc., is used in Holland. **9.** Mention is made of the use in France of a mixture of petroleum pitch, sand and filler as a mortar for bedding iron paving. **10.** It is stated that a bituminous compound of 1·89 specific gravity and 210° F. softening point was used for this purpose in the Mersey Tunnel. This material is said not to become hard and brittle when cold. Abrasion tests on iron paving, in comparison with other types of surfacing, showed that the wear varied from 0·005 in. for iron plate to 0·223 in. for compressed rock asphalt having a rough surface. Reference is also made in this paper to the use of emulsion in curing concrete. In experiments on the Gloucester and Newport Roads in 1932 the bitumen tended to make the surface slippery. **2.** Details are given of experimental sections of stabilized clay surfacings constructed with liquid asphalts. **13.** In an account of rubber surfacings investigated in the Netherlands Indies, extensive data regarding the properties of asphalt–rubber mixtures are given. It is concluded from this work that the temperature to which the mixtures are heated, period of heating and period between preparation and testing have a marked influence on the properties. Mixtures containing more than 7·5 parts of rubber per 100 parts of bitumen lack binding power and are affected by heating. Vulcanized rubber in general has no advantage over unvulcanized rubber, and, in fact, gave lower ductility. Mixtures containing 1–7·5 parts of rubber have lower susceptibility. Ductility is increased, cohesion is increased and adhesion to mineral matter decreased, elasticity increases and length of flow decreases. **16.** Reference is also made to asphalt–rubber mixtures in the paper from Holland. A. O.

1452. Reports on Progress in Preparation and Use of Tar, Bitumen and Emulsions. Perm. Int. Assoc. Road Congr., Eighth Congress, The Hague 1938, *Papers* 21–41. (*The Numbers of the Papers are given below in bold type.*)—**21.** For re-treatment of emulsion penetration or water-bound macadam surfaces a cutback composed of 61/70 penetration bitumen and 8/17% of coal-tar distillate is preferred in North-Eastern Algeria. **22.** The official German specifications for bituminous surfacing are discussed. **23.** Details of construction, in the Argentine, of light surfacings on A. 4 soils are given; surfacings thicker than 2 cm. were too rigid, and cracked when deformation of the base occurred. Testing of materials, commenced in 1935, has been of value, the Association of American State Highway Officials and A.S.T.M. specifications and methods being used. Investigations showed that the viscosity of cutbacks generally increases by 25% of the initial value on storage for 3 months, the original viscosity being reproduced on heating to 200° C. for 1 hr. It is claimed that the adhesion of bitumen to granite can be made superior to the adhesion to limestone by coating the granite with a film of material such as aluminium stearate. **24.** Specifications for tars and tar–bitumen mixtures and the methods of construction with these materials, and with bitumen and emulsions, employed in Australia, are given. **26.** It is stated that in Belgium, bitumen is used principally for asphaltic concrete, topeka and sheet asphalt; tar or tar–bitumen is generally used for surface dressing, but some cutback and emulsion are also employed. Emulsions are used extensively with sand or slag for joint-filling: the methods employed are described. Unstable emulsions may contain 50% or 60% of bitumen, but semi-stable and stable emulsions contain 60%; the Engler viscosity for all types ranges from 3° to 12°, whilst the maximum deposit on the 100 mesh-sieve is 0·5%. The methods of testing emulsions are those adopted internationally, but breaking tests using porphyry are preferred to the lability test. The bitumen is recovered by the A.S.T.M. method, and limits are given for tests on the bitumen. **28.** The lengths of various surfacings on main highways and in towns in Denmark, and figures for yearly consumption of bituminous materials and imports and export of natural asphalt and asphaltic bitumen, are given. It is also stated that a water-soaking test has been found more satisfactory than the Riedel method for examining adhesion; heat treatment of the aggregate appears to improve adhesion. **29.** The more important developments in the United States since 1930 in connection with bituminous materials are discussed; specifications for liquid asphalts are given and types of construction, machinery, research and field investigations are also briefly considered. **30** and **31.** The manufacture, properties, methods of testing and application of road tar, asphaltic bitumen and emulsions in France and Great Britain are discussed. It is pointed out in the former paper that the properties of asphaltic bitumen produced from widely differing crude materials can be varied considerably by use of various manufacturing methods such as vacuum distillation, oxidation or blending with solvent extracts. **32.** The Cságoly method of classification of bitumens according to temperature susceptibility is described, and it is stated that Roumanian bitumen is chiefly used in manufacture of cutbacks in Hungary; coal-tar distillate is the preferred solvent, and small amounts of polar substances are added to improve adhesion. **35.** Figures for production of asphaltic bitumen and emulsions in Japan are given, together with specifications for emulsions and bitumen. More than 90% of the domestic requirement of bitumen is home-produced, and bitumens of less than 100 penetration are used for sheet asphalt, asphaltic concrete, etc., and over 100 penetration for manufacture of emulsions. Mixing emulsions are now available, and tar emulsions are said to be especially suitable for mixing processes and for soil stabilization. Factors affecting the design of various types of surfacing are considered, and numerous graphs relating to mechanical properties are given. Penetrations and ductilities of bitumens extracted from surfacings after 9 years' service show considerable reductions, there being little difference in penetration of the bitumen extracted from different depths in a surfacing. **37.** It is stated that asphaltic concrete chiefly is used for main roads in Holland, whilst in towns sheet asphalt is favoured. Asphalt roads are claimed to have an advantage over other surfacings where the sub-soil is liable to subsidence. **38.** The Polish specifications for road tars and asphaltic bitumen are discussed. The use of the ductility test is recommended for examining the miscibility of tars and bitumen for production of mixtures. Investigations showed that while 20% is generally the maximum amount of bitumen which can be

used, in some cases the amount can be increased to 30%, but not more than 10% of paraffinous bitumen can be employed. Asphaltic bitumens are produced from low paraffin crudes from the South-West Oilfields, and from high paraffin crudes from the South-Eastern Oilfields. The latter form the bulk, and were originally considered unsuitable for road construction, having wax contents of 5–7%. The properties of these asphalts are said to have been improved by vacuum distillation, and they are now used for pre-coating chippings and in heavy surfacings, mixtures of high and low wax content bitumens are claimed to have excellent properties. **39.** The Swedish specifications for materials for road construction are briefly discussed. Mineral aggregates are tested for "flakiness," brittleness and grading. Bitumens range in penetration from 50/70 to 180/300, but specifications for liquid asphaltic products have not been issued, although tests employed are those prescribed in American specifications. Methods for improving adhesion are receiving attention, and the addition of water-insoluble soaps to bitumen have given interesting results, whilst naphthalene in tar appears to improve the adhesion of the latter. Specifications for emulsions require that the water content must not exceed 50%, and must not differ from the declared value by more than 2%. The bitumen must be of 180/300 penetration and, when extracted by D.I.N. 1995 method, must have a melting point of 30–50° C. It is suggested that it may be desirable to include the lability test and viscosity limits in the specifications. **41.** Methods of application and types of emulsion employed in Czechoslovakia are described. A. O.

1453. Examination and Standardization of Carriageway Surfacings from the Point of their (a) Slipperiness or Rugosity and Resistance to Skidding, (b) Light Value or the Degrees to which they Absorb Light (under Artificial Illumination). Perm. Int. Assoc. Road Congr., Eighth Congress, The Hague 1938, *Papers* 68–76.—The papers discuss the factors contributing to slipperiness of a road surface and methods of measuring slipperiness and rugosity. Data relating to coefficients of friction for various types of surfacing under wet and dry conditions are given. The properties of surfacings affecting light absorption and methods of measuring the latter are also discussed. A. O.

1454. Examination of the Sub-Soil of Roads. Perm. Int. Assoc. Road Congr., Eighth Congress, The Hague 1938, *Papers* 78–93.—These reports deal with methods and apparatus used in the examination of the properties of sub-soils, and the influence of the properties on the construction and maintenance of foundations and surfaces. Several of the papers refer very briefly to the subject of soil stabilization but the American paper, No. **83,** deals more extensively with the question of the use of bituminous binders in soil stabilization. A. O.

1455. Method for Recovering Asphalt from Paving Mixtures. H. Suida and H. Hoffman. *Refiner*, August 1938, **17** (8), 386.—The existing methods for the recovering of asphalt from mixtures with sand, aggregate, etc., are criticized, on the grounds that they are cumbersome owing to the large volumes of solvent needed, dangerous owing to the inflammability of the CS_2 which is the normal solvent, and unreliable owing to chemical action of solvents such as CS_2, $CHCl_3$ and CCl_4. In the suggested method benzol is the solvent used. The apparatus consists of an iron autoclave fitted with a condenser coil depending from the head. To this coil is attached a filter bag containing 1–2 kgm. of the sample. The solvent (200–300 ml.) is contained in a 600-ml. beaker in the bottom of the autoclave. Air in the autoclave is replaced by an inert gas, and extraction is carried out at the b. pt. of benzol. After extraction the solution of binder is centrifuged to remove filler, and the binder recovered by distillation at low pressure in an inert atmosphere. Figures published show that the recovery process has a negligible effect on the properties of the binder. H. G.

1456. Investigation of Formation of Asphalt by Oxidation of Heavy Distillates. H. Kamptner and W. Maass. *Asph. u. Teer*, 1938, **38** (41), 679–687.—The effect of the nature of the starting material on the formation of asphalt has been investigated by blowing air through a series of naphthenic, paraffinic and asphaltic base distillates of

6·5°, 10·5° and 17° Engler viscosity. Blowing was carried on at 180/190° C. for periods of 76, 61 and 91 hrs. with 28,700, 23,000 and 34,400 litres of air for 8 kgm. of oil. Properties of the distillates and asphaltic material and slop oil produced are tabulated, and photomicrographs of the asphaltic materials are reproduced. It is stated that no relation exists between loss on heating of the distillate and yields of slop oil or gas; yields of slop oil are greatest for the asphaltic distillate, whilst the paraffinic oil gave greatest yield of gas, and the naphthenic oil was intermediate in both respects. The slop oil was strongly acid; specific gravity was lowest with the paraffinic and highest with the asphaltic oils; content of resin and oily material varied considerably and hard asphalt content was low. In the residues the content of oily material decreased, and resin and hard asphalt increased with increase in time of blowing, and soft asphalt was not formed. With the naphthenic and paraffinic oils, acidity and free carbon increases, whereas none of the residues from the asphaltic oils contained free carbon, and acidity decreased. In the naphthenic oils only resins are at first formed, whereas in the paraffinic and asphaltic oils both resins and asphalt are formed. The hard asphalt content of the paraffinic residues did not change appreciably after 40 hrs., but free carbon increased, whilst the asphaltic residues showed only slight increase in resin after 40 hrs., but hard asphalt increased. It is concluded that asphaltic oils are ideal for investigation of asphalt formation, paraffinic and naphthenic oils give inhomogeneous products in which free carbon is found, and that asphaltic distillates contain large amounts of aromatic and hydroaromatic hydrocarbons which keep the asphaltenes in solution. A. O.

1457. Classification of Asphaltic Bitumens. J. P. Pfeiffer and P. M. Van Doormaal. *Petrol. Z.*, 20.7.38, **34** (29), 12.—An account of published work, describing the derivation and significance of *penetration index*.

Nomograms are given for the ready determination of the index by means of the R. & B. m. pt. and penetration at 15° C., 25° C. or 40° C. P. G. H.

1458. Chemistry in Road Building. W. Skalmowski. *Przeg. Chem.*, 1938, **10** (10), 610–613.—A survey of the application of chemistry to the construction of road surfaces is given. The production, testing and application of asphaltic bitumen and tar for road building purposes are discussed. E. J. W.

See also Abstract No. 1434.

Special Products.

1459. Patents on Special Products. S. L. M. Saunders. E.P. 487,681, 20.6.38. Preparation of drying oil by heating in the absence of alcohols or other OH bodies, castor oil containing a hydroxylated fatty acid—at temperatures above 200° C. with phthalic anhydride.

E.I. Du Pont de Nemours and Co. E.P. 488,428, 6.7.38. Stabilization of parasiticidal compositions containing thiodiphenylamine as an active constituent by adding a small proportion of β-naphthol or of hydroquinone.

G. Natta. E.P. 492,073, 14.9.38. Synthesis of methanol from CO and H_2 and steam using as catalyst ZnO prepared by heating zinc acetate until it decomposes.

Junkers Flugzeug und Motorenwerke, A.G. E.P. 492,971, 30.9.38. Agent for extinguishing burning light metals consisting of an emulsion of water and oil (75% of water and 25% of technical oil containing 10% of saponifiable constituents together with 100–200 gm. of soluble silicates and 10–40 gm. of ammonium carbonate).

G. W. Johnson. E.P. 492,980, 30.9.38. Manufacture of vinyl chloride by leading C_2H_2 and HCl through a container containing mercury at 100° C., then at 130° C., and then over active carbon. W. S. E. C.

Detonation and Engines.

1460. Thermodynamic Analysis of the Rate of Pressure Rise in the Otto Cycle. G. G. Brown. *Chem. Rev.*, 1938, **22** (1), 27.—The Otto Cycle is examined from the thermodynamic standpoint, and the deviations in practice from the ideal cycle are explained.

Knocking and non-knocking cycles are compared, and estimations are made of the loss in power and rise in maximum pressure associated with knocking explosions. Attention is directed to the local nature of the detonation pressure rise, which is mainly confined to the detonating area. The loss in efficiency is due to the thermodynamic irreversibility of the pressure equalization.

The author considers that the thermodynamic method is important in analyzing engine characteristics such as knocking, running roughness, rate of pressure rise, and the effects of supercharging, and also as a means of predicting the characteristics of combustion cycles associated with different fuel types. J. G. W.

1461. Chemistry of Otto-Cycle Engine Combustion. H. A. Beatty. *Chem. Rev.*, 1938, **22**, 51.—During normal combustion, after an ignition lag of 1 millisecond, the flame accelerates rapidly to a velocity of 100 ft. per second, the pressure rise is smooth and noiseless and its maximum rate is of the order of 1000 lb./sq. in. per m. sec. The flame spectrum is normal, and shows C–C and C–H bonds. The inflammation is assumed to be a chain reaction process in which the interaction between the chain-carriers and the reactant molecules requires a considerable energy of activation.

In abnormal combustion (knocking) a form of spontaneous ignition starts at one or more points in the unburned charge ahead of the flame front, and the knock flame sweeps through the remainder of the unburned charge at a velocity of 1000 ft. per sec.; the corresponding rate of pressure rise is high, the maximum value being of the order of 10,000 lb./sq. in. per m. sec. This rate of pressure rise sets up pressure waves, which induce the emission of sound from the engine. The spectral emission of the knocking flame resembles the normal flame, but it has a greater extent, and the intensity of the characteristic hydrocarbon C–C and C–H bonds is weak or disappears. Formaldehyde appears in the unburnt charge ahead of the flame in increasing amounts, and compounds of the peroxide type are also present.

The influence of anti-knock compounds is to suppress the formation of those undesirable compounds which, under the conditions of incipient knock, give a continuous absorption in the residual unburned charge. J. W. H.

1462. The Combustion Process in the Diesel Engine. G. D. Boerlage and J. J. Broeze. *Chem. Rev.*, 1938, **22** (1), 61.—The problems associated with mixture formation, ignition and the various stages of combustion are examined in detail.

Atomization, spray distribution and turbulence are considered in regard to the best utilization of the air available, and attendant disadvantages of particular systems are discussed.

The chemical and physical delay time before ignition can take place and their effect on the indicator diagram and the performance of the engine are described. Details are given regarding the contributing effects of engine-design characteristics and operating conditions.

The combustion stages are also examined from the physical and chemical aspects. J. G. W.

1463. Factors Controlling Diesel Engine Performance. A. M. Rothrock and R. F. Selden. *Chem. Rev.*, 1938, **22** (1), 89.—Spray nozzle design is described in relation to spray distribution, drop size and penetration. Experimental data regarding the performance of various designs of nozzle are given.

The authors include flame photographs to illustrate the process of combustion and compare various types of combustion chamber. The factors controlling combustion and affecting the general performance are discussed. J. G. W.

1464. Surface Finish Related to Wear in Internal-Combustion Engines. K. W. Connor. *J. Soc. aut. Engrs*, 1938, **43**, 305–312.—Surface finishes of cylinder bores and other parts of internal-combustion engines are now produced on a production

basis within much finer limits than has been possible heretofore. Surface finishes in which the running average of the height of the irregularities may be held uniformly less than five millionths of an inch for bores, five to eight millionths for pistons, and from one to two millionths of an inch on bearings, are now being produced.

The generation of such finishes is being accomplished by newly developed hydraulic honing tools, and a suitable instrument for measuring and maintaining factory production to the required limits.

This measuring instrument is a development of the Profilograph which was invented several years ago, but which has now been produced in a form suitable for factory equipment. The tracer method is used in which a fine point travels over the surface, and the movements of the point at right angles to the surface generate voltages in a permanent magnet circuit proportional to the velocity of varying direction of tracer movement. These voltages are amplified and caused to produce horizontal and vertical displacement of the spot of a cathode-ray oscillograph. Details are given of the operation of the hydraulic hone equipment and many photomicrographs of surface finishes.

The author concludes that the adoption of such equipment indicates new opportunities for obtaining more definite correlated data on engine wear. C. H. S.

See also Abstract Nos. 1413 and 1437.

Coal and Shale.

1465. The Production of Active Carbon from Bituminous Coal. J. G. King, D. MacDougall and H. Gilmour. D.S.I.R. Fuel Research Tech. Paper No. 47, 1938.—At present active carbon is being manufactured from coal mainly by one firm in this country by a process involving very fine grinding of the coal, briquetting at a high pressure in the absence of a binder, carbonizing at a relatively low temperature and activating the coke with steam. The present investigation covers the use of lump coal carefully graded without briquetting. Careful choice of the type of coal is necessary, since the cells developed in high coking coals are too large and are further enlarged on activation. Dull hard coals (durains) which are rich in plant remains are widely available, and form the most promising source of supply, since on carbonization these remains volatilize or fuse, giving the required cell structure. Cannel coals also rich in plant remains are, however, unsuitable, as they do not develop the same structure.

Tests were carried out on the laboratory, semi-technical and technical scale and the optimum conditions determined, the carbon obtained being tested for adsorption and decolorization quality for friability.

The most suitable coal was that from Sherwood colliery, Notts., the optimum conditions being carbonizing at 480° C. or a little higher, and activating the pieces of coke up to an inch in size at 950–980° C. with 10 lb. steam per hour per 5·4 lb. coke.

Plant yields were as follows: out of 100 tons lump coal crushed, 45 tons were rejected after grading, the 55 tons producing on carbonization 40 tons of coke and 220,000 cu. ft. of gas at 800 B.Th.U. per cu. ft. 5 tons of the coke were rejected after screening as fines, and the remaining 35 tons activated yielding 3,115,000 cu. ft. of water gas at 300 B.Th.U. per cu. ft. and 11 tons of activated coke.

For purposes such as solvent recovery, use in gas respirators, etc., sized or graded carbon of high abrasion resistance is required, but for the decolorization of *e.g.* edible oils, glycerol, sugar solutions, the purification of water or the deodorization of effluents, granular strength is not necessary, as the carbon is used as a finely divided powder. The activated coke yielded 70% of crushed material suitable for respirators (*i.e.*, 8% of the lump coal). This could probably be improved with more suitable crushing apparatus. The coal carbon had only 50% of the adsorption capacity of commercial carbon when used for the recovery of benzol from coal gas. Some improvement was obtained by using a mixture of air and steam for activation. With CCl_4, the coal carbon gave an adsorption capacity more in line with that of commercial carbons. Coal carbon had a lower decolorizing efficiency than commercial carbons for brown sugar solutions, and permitted the development of acidity. Attempts to improve these were unsuccessful. For the decolorization of glycerol the coal carbon was equal to bone carbon, and for palm-kernel oil considerably superior. C. L. G.

1466. Destructive Distillation (of Coal). R. V. Wheeler. *J. Inst. Fuel*, Oct. 1938, **12** (61), 8.—A summary is given of the more important work on the constituents of coal obtained by vacuum or atmospheric distillation or the use of solvents, and of the individual types of coal (vitrain, clarain, durain and fusain), on the chemistry of the plant entities recognizable in coal, on the oil-yielding constituents and on the active decomposition point of coal.

Below 300° C. there is little decomposition of most bituminous coals with more than 80% carbon, the greater part of the free hydrocarbons distilling unchanged between 220° and 300° C. The plant entities decompose slowly between 310° C. and 350° C. or between 300° C. and 320° C. if the duration of heating is considerably prolonged, yielding oxides of carbon, water and heavy oil containing mainly unsaturated hydrocarbons and neutral oxygenated compounds. The actual decomposition point of the ulmin compounds varies with the carbon content of the coal (viz., with coals of 77–90% carbon, the temperature increased from 290° C. to 365° C.), the products being gaseous paraffins, water, phenol oils and liquid aromatic and hydroaromatic compounds. The production of oils is confined mainly to a temperature range of 25–30° C. above the active decomposition point. Above this point, ulmin compounds, organized plant entities and resins decompose and distil simultaneously, yielding a complicated mixture of liquid products. With coals containing a high proportion of plant entities yielding such hydrocarbon oils on decomposition, some of the resins are distilled unchanged at 325–375° C., the remainder being decomposed. C. L. G.

1467. Modern By-Product Coking. Anon. *Fuel Econ.*, 1938, **14** (155), 277–279.—The article describes the general methods in use for the recovery of benzole from coke ovens and gas works. As regards the former, the industry is based on either the supply of metallurgical coke or of domestic coke, and it is unusual for a given plant to manufacture both varieties, although circumstances will dictate which is being made.

The article describes the type of oven in use and the effect of carbonizing conditions on the yield of benzole. This can be increased by three methods, namely: (1) the Still method, (2) the Goldschmidt method, and (3) the Koppers method. These are briefly described. General steam consumption on a recovery plant, including that required for the distillation of the crude, is given approximately as 5 lb. per lb. of benzole recovered. Continental developments include the introduction of a pipe-still system for distillation of the enriched wash oil, and in this country the Clayton still for continuous regeneration of creosote, when this is used as the absorption medium.

The average yield of benzole from the whole of the coke ovens in this country is said to be between 3 and 3·1 gals. per ton of raw coal carbonized, and 98% of the gas produced is treated.

As regards the gas industry in 1937, 47% of the gas made was treated for benzole recovery, and the average yield was 2¼ gal. of crude per ton of coal carbonized. The lower yield is partly accounted for by the fact that most gas works prefer to take out only about half of the benzole present in the gas. The difference between the two industries is that in the by-product coking plant the benzole is regarded as an end product of great commercial importance, whereas in the manufacture of gas the benzole is regarded as a comparatively useful method of reducing the cost of gas-making.

The article concludes by suggesting that an electrical coking process may develop in the next few years at points conveniently adjacent to cheap electric power for large-scale and rapid coke output. W. E. J. B.

1468. Patents on Coal and Shale. H. Rosenthal. U.S.P. 2,132,441, 11.10.38. Recovery of petroleum oil from oil-shale by extraction with propane.

R. E. Burk. U.S.P. 2,133,280, 18.10.38. Extraction of bituminous solid substances—*e.g.* coal—using ammonia, and subjecting the dissolved constituents, after separation of ammonia, to cracking heat. W. S. E. C.

Economics and Statistics.

1469. Stocks of Petroleum Products in Germany. Anon. *Przem. Naft.*, 10.10.38, **19**, 325.—Among many other statistical data are tables showing the production of oil (natural and synthetic) in Germany, the import of petroleum products and their consumption. E. W. J.

ERRATUM.

Abstract No. 1320, November Journal, 1938. **Saturated High Octane Fuels without Hydrogenation. The Addition of Olefines to *iso*Paraffins in the Presence of Sulphuric Acid.** S. F. Birch, A. E. Dunstan, F. A. Fidler, F. B. Pim and T. Tait. *J. Instn Petrol. Tech.*, 1938, **24**, 303–320.

The abstract should read :

The process for the manufacture of saturated high octane fuels by the addition of olefines to *iso*paraffins in the presence of sulphuric acid is thoroughly investigated, and its possibilities explained.

BOOK REVIEWS.

Introductory Economic Geology. By W. A. Tarr. Pp. xii + 645. McGraw-Hill Publishing Co., New York and London, 1938. 30*s*. net.

Eight years have elapsed since the publication of the first edition of this work. The new edition takes cognizance of the changes which have occurred during that period, for advances have been made in the knowledge of the geology and distribution of the useful earth materials; some materials are now less extensively employed; others have found new applications, and uses have been found for hitherto unused earth materials. The length of the work, its general form and the proportions of its various parts are essentially unaltered in the new edition. Such changes as have been made have been mainly of the form of trimming. The space devoted to obsolete ideas which have, however, some historic interest has been reduced; additions have been made on the metallurgy of various metals, and the statistics have been brought up to date wherever possible, in many instances being presented in more vivid forms. Numerous diagrams have been re-drawn, a few deleted and new ones have been added. Additions have also been made to the reading lists.

The first part of the book deals very briefly with the history of the earth materials used in past ages, and points out the utter dependence of modern civilization on such materials. The general principles governing the formation of mineral deposits are discussed, and it is evident that Tarr is a very strong believer in the magmatic origin of inorganic mineral deposits, with the consequent relegation of meteoric waters to the limited rôle of agents of the important secondary changes which certain mineral deposits have undergone. In the second part the metallic earth materials are described, whilst the third part, on non-metallic earth materials, includes chapters on coal, petroleum and natural gas, structural materials (clay, cement, stone, lime, sand, gravel, mineral pigments, asbestos, asphalt, mineral wool and gypsum), materials used chemically and materials of miscellaneous uses (abrasives, fillers, refractories, absorbents, etc.).

In general, for each substance the following points are dealt with: mineralogy, mode of occurrence, methods of production and treatment, distribution of deposits, mode of origin, applications and statistics. It should be noted that the descriptions of the deposits are almost entirely of U.S.A. occurrence. Foreign deposits have been treated most cursorily. This latter feature is responsible for some notable misrepresentations and inaccuracies in the chapter on petroleum. On a map England is honoured with a black spot indicative of an oil-field, and the same is true for Papua and New Guinea, whereas according to the text Germany has only one oil-field. Moreover, there seems no reason why the map, at least, should not have given a better idea of the widespread occurrence of oil in the U.S.S.R. Nevertheless, the account of the theories of the origin, of the geology and the methods of production of oil and gas is neatly concise and up to date.

One or two doubtful statements have been noted, and there are slips which are mainly lapses in terminology. These, however, are minor points. Some may feel that the methods of treatment and the uses of earth materials have been described at the expense of the geology and distribution, but it is clear that Tarr intended to satisfy the students' interests thereby. Perhaps the title should have been broader, for the author has provided a wealth of information on a very wide field.

G. D. Hobson.

The Principles of Motor-Fuel Preparation and Application. By A. W. Nash and D. A. Howes. Vol. I. Second Edition. 1938. Pp. 628. Chapman and Hall, Ltd., 11 Henrietta Street, London, W.C.2. Price 36*s*.

When the first edition of this volume was published in 1934, it had a great and immediate success. Within a short time it was to be found on the bookshelves of

almost every organization which was in any way connected with the petroleum or automobile industries, and it must at some time or other have proved a most valued work of reference to every petroleum technologist concerned with the production and use of petrol. Incidentally, it should be noted by those concerned with compression ignition motors that the title is to some extent misleading, because the book deals only with fuels for the spark-ignition engine.

We are as pleased as the authors and their publishers must be that the success of their work has justified a second edition. There is also another reason for this gratification. Petroleum science and technology are advancing so rapidly to-day that books such as this must have frequent revision, or they very soon become obsolescent, and nothing shakes a reader's faith in a technical reference book more than a realization that certain sections of it are to his own knowledge erroneous, incomplete or obsolete. No one probably realizes this more than the authors, who must have been only too glad of the opportunity to revise and extend certain chapters which were beginning to show signs of old age.

It should scarcely be necessary to recapitulate in detail the main contents of this work. Briefly, it deals with every aspect of the production of fuel for the spark-ignition motor (testing and analysis are dealt with in Volume II), from the distillation of the crude oil and the stripping of gas and cracking of heavy oil, which together give us our raw fuel material, through the stages of various refining treatments, to the final phase of storage and distribution. The production, properties, uses, advantages and disadvantages of alternative volatile fuels such as benzole, alcohols, shale spirit, hydrogenated coal spirit and other synthetic materials are each dealt with with equal thoroughness.

In the brief space of four years, however, great advances have taken place in certain aspects of the petroleum industry, and it has been necessary to incorporate these in the new edition by extending and modifying some chapters and adding new ones. The development, for example, of the catalytic polymerization processes which convert gaseous olefines (hitherto waste by-products of the cracking operation) into motor fuels of high anti-knock quality, and even into super-high-octane aviation fuel, has necessitated an entire new and lengthy chapter. The alternative "pyrolysis" processes which by non-catalytic methods have also successfully utilized the waste gases of the petroleum industry for the manufacture of high-grade petrol, also receive their due share of description, and this new chapter ends appropriately with a general comparison of the alternative methods now available for the production of synthetic gasoline from petroleum gases.

While this section is the most prominent addition to the first edition, almost every chapter has been brought up to date by the addition of new material. Only one section in which much new knowledge has been acquired in recent years seems to have been overlooked, for the latest reference in the bibliography of natural gasoline is 1930, and the extensive researches of recent years into the methods whereby greater quantities of stable natural gasoline can be incorporated in motor spirit without increased risk of vapour lock and with great improvement as regards starting and warming up, have not received the attention they deserve.

A critic may perhaps consider that in parts the balance is not too well preserved, certain lines of research with which the authors have been personally concerned receiving rather unnecessarily elaborate and detailed description at the expense of others which have been given rather scanty treatment.

No book, however, is perfect, and with such a high general standard, it is ungracious to cavil at details. We can congratulate both the authors and their public on the advent of this new edition, and hope that the successor to Volume II will appear in due course.

F. B. THOLE.

Mitteilungen aus der Dachpappenindustrie, 1938. II. Jahrgang. Pp. 162. Illustrations 110. Allgemeiner Industrie-Verlag Knorre & Co., K.-G., Berlin. Price R.M. 6.

This book consists of a series of papers on the manufacture, utilization and testing of roofing felts primarily, although it does include also two sections on natural and synthetic mastic asphalt. It is prepared under the auspices of the Roofing-Felt Manufacturers in Germany. The first paragraph of the book attributes the earliest manufacture of roofing felt to a German in 1828, whereas

Abraham in "Asphalts and Allied Substances" quotes a contemporary reference stating that a factory was established at Geneva for the manufacture of paper impregnated with asphalt from Neuchâtel for use as tarpaulins, packing paper, imitation oil cloth, etc., in 1820.

This book is of special interest to English readers, since bitumen-impregnated felts are used in Germany for waterproofing purposes to a considerable extent in positions and for purposes where mastic asphalt would be employed in this country. As already mentioned, there are a number of papers which are grouped under twelve different subjects, the first on the historical development of roofing felt in Germany, and the second on shrinkage of concrete and its effect on bituminous waterproofing layers in contact with it. Other papers deal with the application of roofing felts for waterproofing purposes in connection with various forms of building construction, as, for example, in basements and other locations, where the structure must be made tight against water-penetration. The manufacture, testing and application of roofing felts in the United States are the subject of an interesting article by Dr. Temme. In one paper on the application of bituminous paints to water tanks and silos, reference is made to the effect of these materials on the taste and smell of drinking-water, with additional references to other liquids met with in practice, such as brine and sauerkraut juice. A paper on the development and manufacture of synthetic and natural mastic asphalts by Müller is rather general in scope. The following chapter, on the use of natural asphalt as a covering material for bridges in conjunction with concrete, is distinctly practical, and contains some ten illustrations.

Some sixty pages of the book are devoted to laboratory reports, of which the larger part is from Horst Walther, leader of the chief laboratory of the Union of Roofing-Felt Manufacturers in Germany; this section gives details of laboratory investigations, such as would normally be published in technical journals, and thus differs from the remainder of the book, which consists of a series of reviews of special subjects coming within the scope of the roofing-felt industry. This particular section is, however, of great interest and is subdivided as follows :—

(*a*) The estimation of the bitumen content of mixtures of coal tar, pitches and bitumen by the measurement of dielectric constants.

(*b*) The absorption of water by bituminous sheets as affected by mineral fillers and water pressure; two types of bitumen, in addition to coal tar and pitch and five different types of fillers were used.

(*c*) On the chemical processes involved in the oxidation of bitumen, which includes a brief description of the effect of anti-oxidants such as hydroquinone and β-naphthol.

(*d*) Dealing with the damage to bituminous roofing felts, on the one hand by birds in search of food, and on the other hand by the growth of grass. A final paper deals with the resistance of bituminous sheets to air pressure, in which the conclusion is reached that the resistance is proportional to temperature, and that the lower the effect of temperature on the hardness of the material, the greater is the resistance to pressure.

The book presents information on roofing felts, a subject on which little reliable information has been published, and is of special interest, since it is sponsored by a group of roofing-felt manufacturers. F. H. Garner.

The Science of Petroleum. Editors: Dr. A. E. Dunstan, Professor A. W. Nash, Dr. B. T. Brooks and Sir Henry Tizard. **Volume III. Chemical and Physical Principles of the Refining of Mineral Oils** (being Part II, Sections 26–39). Pp. 1671–2385. (Oxford University Press, London, New York and Toronto. Four Volumes, £15 15*s*. net.)

Translated from a review in French by M. Louis.

This volume is a continuation of Volume II, the second part of which also deals with Refining, and comprises Sections 26–39.

The work is chiefly devoted to an explanation of refinery operations by reference to scientific knowledge and theories. Each chapter is prefaced with a summary of general laws which "refreshes" the mind of the reader, and often completes

his knowledge by a brief review of the most recent work on the subject. Then follows the application of these laws to refining, and then only thirdly are refinery operations described, with particular reference to the most recent problems and their solution.

Each article is accompanied by a bibliography, but references to literature up to the date of preparation of the work only are given—that is to say, up to 1936. The reader can thus quickly follow up any particular problem, and can easily trace it back to its origin.

The volume commences with a study of the physical processes of refining, of which adsorption is the most generally employed. Following the scheme indicated above, a brief review is first given of the properties of surfaces, followed by the application of these phenomena to refining, in particular to cracked gasolines.

A long chapter is devoted to chemical refining. The properties of the undesirable constituents of white spirits are described at some length, together with their reaction with the principal products employed in refining. These principles having been enumerated, the processes are then described, and the engineer will find here descriptions of apparatus with calculations and diagrams (contactors, mixers, etc.). The theoretical chapter concerning the oils is shorter because little is known regarding their composition.

In Section 26 there is a very complete account of the theory of solvents, together with methods of calculation and numerous graphs. These are very valuable, and can serve as guides to subsequent work. In many cases they show practical results obtained with different solvents. The action of certain factors, which influence the yield, are also shown on graphs.

Dewaxing processes are described in Section 29, and include the most up-to-date—precipitation by propane. Happily this account is completed by an article on a subject not strictly pertaining to petroleum—refrigeration, an article illustrated with an entropic diagram of carbon dioxide.

Section 30 is devoted to a technique, recently introduced into the petroleum industry—polymerization. The pyrolysis and polymerization of pure hydrocarbons and of gaseous paraffins are described with numerous figures and graphs. The article concludes with the industrial application of these principles to the preparation of liquid fuels of high octane number.

With regard to cracking, which is already an established technique in the petroleum industry, the book describes the newest applications (combined units, reforming, etc.). The theory of cracking and of the pyrolysis of hydrocarbons—questions which are always studied—naturally find their place in this section.

Finally, in Section 32, hydrogenation is dealt with, a method which promises much, but the employment of which has not spread greatly.

After Section 33 the book is addressed more especially to the technician. First of all there is a series of important articles on heat transfer, conductivity, emissivity, then many very useful figures and graphs on exchangers, heaters and thermal insulators.

Towards the end of the volume there are articles on the metals and alloys used in the construction of refineries, together with their characteristics, and, as a corollary, an account of their attack by corrosion. Finally a brief review is given of apparatus for measurement and control.

In this volume the account of refinery operations is given in accordance with the title "The Science of Petroleum"—that is to say, rather from a theoretical than from a practical point of view. The practical man will not find details of refineries, nor a thorough description of the apparatus. But, nevertheless, he will be interested to look through this book, which is written with the clarity necessary for him to grasp the intricate fundamentals of refinery operations and to "master the matter." Such a cultivation of the mind is the generator of progress.

The scientist will find there substantial food for thought, and, as well as the high quality of the information given, he will see a happy and productive link between science and industry.

M. Louis.

BOOKS AND PUBLICATIONS RECEIVED.

British Standard Specification No. 587. Revised 1938, for Motor Starters and Controllers and Resistors Employed Therewith. British Standards Institution, 28, Victoria Street, London, S.W.1. Price 2*s*.

This specification covers the various types of apparatus for the starting and for control of D.C. and A.C. electric motors. Hand-operated and automatic patterns are included, and the following models—face-plate, drum, multiple-switch, and contactor—together with variants of these. The specification also covers resistors and auto-transformers, whether forming part of, or forming self-contained units for use with, starters or controllers.

British Standard Specification No. 812. Methods for the Sampling and Testing of Mineral Aggregates, Sands and Fillers. Pp. 40. British Standards Institution, 28, Victoria Street, London, S.W.1. Price 3*s*. 6*d*.

Proceedings of the Institution of Mechanical Engineers. Vol. 139, 1938, April–May. Pp. xvi + 576. The Institution, London.

Of particular interest among the papers in this volume is one on Cutting Tools Research, being a Report of the Sub-Committee on Carbide Tools. Included among the other papers is a report on "The Design and Operation of a Modern Blooming Mill," by W. F. Cartwright, and one on "The Transmission of Superheated Steam over Long Distances," by Prof. L. F. C. A. Genève.

Journal of the Iron and Steel Institute. No. 1, 1938, Vol. CXXXVII. Proceedings, pp. 1P–410P; Bibliography and Abstracts, pp. 1A–374A; Indexes, pp. 1–70.

The first section comprises the Minutes of Proceedings, and includes eleven papers presented at the Annual General Meeting, 1938. Section II contains a survey of literature on the manufacture and properties of iron and steel.

The Hydrogenation-Cracking of Tars. Part IV. Production of Aromatic Hydrocarbons from Phenols at Atmospheric Pressure. Fuel Research Technical Paper No. 48. Pp. vi + 55. H.M. Stationery Office, London. Price 1*s*. 3*d*.

Parts I–III of this series of Reports dealt with the conversion of low-temperature tars into light spirits by treatment with hydrogen under high pressure and at high temperatures. The present Report describes experiments on the conversion of a portion of these tars—the tar acids—into aromatic hydrocarbons by treatment with hydrogen at atmospheric pressure.

Origin of the Cap Rock of Louisiana Salt Domes. Geological Bulletin No. 11. Pp. 191. Department of Conservation, Louisiana Geological Survey. New Orleans, La.

This bulletin deals with a study of the origin of the cap rock that overlies many of the Gulf Coast Salt plugs, and the nature of the relationship between the rock and salt. The study comprised a collection of all available data concerning the occurrence of both types of rock bodies, combined with petrographic studies of the cap rock and the salt. Evidence is produced which points to the conclusion that the anhydrite cap rock of the salt domes of the North American Gulf Coast region is a residual accumulation of the relatively water-insoluble materials in the rock salt of the associated salt plugs.

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INSTITUTION NOTES.

JANUARY 1938.

FORTHCOMING MEETINGS.

Tuesday, 8th February, 1938, at the Royal Society of Arts, John Street, Adelphi, W.C.2, at 5.30 p.m.

"Air Raid Precautions, with Reference to the Storage of Petroleum." Address by Lt.-Col. R. A. Thomas, C.B.E. (Home Office).

N.B.—No advance copies of this Address will be printed.

Monday, 28th February, 1938, at Burlington House, Piccadilly, W.1, at 8 p.m. Joint Meeting with the Society of Chemical Industry, Road and Building Materials Group.

Discussion on "The Ageing of Bituminous Materials."

Tuesday, 1st March, 1938, at the Institution of Civil Engineers, Great George Street, S.W.1, at 7 p.m. Joint Meeting with the Institution of Automobile Engineers and other Societies.

Essential Road Conditions Governing the Safety of Modern Traffic.

Road Planning:	Dr. T. Adams.
Road Construction:	C. Havard Humphreys.
Road Illumination:	L. J. Davies and G. S. Lucas.

Tuesday, 22nd March, 1938, at the Royal Society of Arts, John Street, Adelphi, W.C.2, at 5.30 p.m.

Annual General Meeting.
Presidential Address by Lt.-Col. S. J. M. Auld, O.B.E., M.C., D.Sc.

6th–11th June, 1938, at Glasgow. **Conference on Oil Shale and Cannel Coal.**

ELECTION OF PRESIDENT.

At the Council Meeting held on 16th December, 1937, Lt.-Col. S. J. M. AULD, O.B.E., M.C., D.Sc., was unanimously elected President of the Institution for the year 1938–1939.

ELECTION OF VICE-PRESIDENTS.

The following members of Council have been elected Vice-Presidents for the year 1938–1939:

ASHLEY CARTER, A.M.I.Mech.E.
C. DALLEY, M.I.E.E.
Dr. F. H. GARNER, Ph.D., M.Sc., F.I.C.
Prof. A. W. NASH, M.Sc.
J. McCONNELL SANDERS, F.I.C.
Dr. F. B. THOLE, D.Sc., F.I.C.

AWARD OF BURGESS PRIZE.

Mr. A. H. NISSAN, B.Sc., Stud.Inst.P.T. (Birmingham University), has been awarded the Burgess Prize for his essay on "An Investigation into the Cost of Oil Absorption Plant for Natural Gasoline Recovery at High Pressure and Low Temperature."

As announced in the Institution Notes of November 1937, Mr. A. H. Nissan was also awarded the Students Medal for this essay.

NEW MEMBERS.

The following elections were made by the Council in accordance with the By-Laws, Section IV, para. 7, at the Council Meeting held on the 11th January, 1938.

Elections are subject to confirmation in accordance with the By-Laws, Section IV, paras. 9 and 10.

Members.

HOYTE, William Norman	London.
PEUTHERER, Willison Bryce	Midlothian.
SMITH, George Henderson	Westlothian.
SMOLEY, Eugene Ralph	New York.

Associate Members.

BERTENSHAW, Stanley Weaver	Leeds.
BURSLEM, John	Trinidad.
CHALMER, Stanley O.	Melbourne.
COX, Frederick James	Blackpool.
EVERIST, Geoffrey Edward	Croydon.
GOW, DOUGLAS	Sarawak.
HARDIMAN, Eric W.	London.
MASKELL, Laurence Ormes	London.
WARDROP, Ian Dalglish	Leigh-on-Sea.

Transfer to Associate Member.

JACKSON, James	Sarawak.

Students.

DAVIES, Thomas Trevor	London.
DE FREITAS, Henry Anselm	London.
GOODFELLOW, Alfred John	London.
HEISCH, Godfrey Edward	London.
HINTON, Cedric Alan	London
KANE, John	London.
MCGINTY, James	London.
TAVANA, J.	London.

Associates.

MILLER, John Thomas Veness	London.
SHAW, Ralph	Gateshead.
THEMOIN, Henry F.	Paris.

CANDIDATES FOR ADMISSION.

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BARTLEY, Brian Edward, Trainee (*Limmer and Trinidad Lake Asphalt Co., Ltd.*), Dunkeld, Elm Park Road, Pinner, Middx. (*A. W. Attwooll ; V. V. L. Hope.*)

BOSHELL, Ernest Gerard, Assistant Chemist (*Anglo-Iranian Oil Co., Ltd.*), c/o A.I.O.C. Abadan, Iran. (*H. C. Tett ; E. A. Evans.*)

COLLCOTT, John Sanders, Chemical Engineer (*Vacuum Oil Co.*), 12, Longfield House, Uxbridge Road, Ealing, W.5. (*S. J. M. Auld ; W. E. Gooday.*)

DRIVER, Percival, Chemist (*Alexander Duckham & Co.*), 28, Broad Walk, Kidbrooke, S.E. (*Trans. from A.-M.*) (*J. S. S. Brame ; S. E. Bowrey.*)

EMERY, Douglas John, Assistant Chemist (*L.N.E.R.*), "Langford," 96, King's Avenue, Woodford Green, Essex. (*S. J. M. Auld ; G. Patchin.*)

ENGEL, Bruno, Chemist (*A.B. Separator-Nobel*), c/o A.B. Separator-Nobel, Stockholm, Sweden. (*S. Beskow ; N. Backlund.*)

HOGGAN, Vivian Glen Ewart, Representative (*Vacuum Oil Co.*), 15, Bungalow Cantonments, Mhow, Central India.

KIDD, Thomas George, Chemist (*Anglo-American Oil Company, Ltd.*), 3, Queensborough Gardens, Barkingside, Essex. (*H. C. Tett ; A. Hamilton.*)

KRAUSE, William F., Research Chemist (*Globe Oil & Refining Co.*), 34, Logan Street, Lemont, Ill., U.S.A.

MANDELBAUM, Malvin R., Chemical Engineer, c/o Process Management Co., 120 E. 41 Street, New York, N.Y., U.S.A. (*C. K. Francis ; B. T. Brooks.*)

MYHILL, Walter Edward, Technical Sales Executive (*Phœnix Oil Products, Ltd.*), Strada Gen. Berthelot, 90, Bucarest, Roumania. (*T. S. Masterson ; E. Boaden.*)

OWEN, Arthur George Albert, Refinery Engineer, Anglo-Egyptian Oil Refinery, Suez, Egypt. (*G. W. Dorrell ; A. D. Cooper.*)

STANLEY, George Arthur Vickers, Geologist (*Oil Search, Ltd.*), 33*a*, Battery Street, Clovelly, Sydney, N.S.W., Australia. (*A. Wade ; K. Washington Gray.*)

VASCHALDE, Andre, Engineer (*Pechelbronn S.A.E.M.*), 12, rue Pierre Ducreux, Paris, 16e. (*A. Pelissier ; C. T. Longcroft.*)

WATLING, Reginald Albert, Draughtsman (*Burmah Oil Co., Ltd.*), 131, Well Hall Road, Eltham. (*J. F. Taylor ; B. J. Ellis.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Mr. A. CHADWICK has returned from Trinidad.
Dr. J. A. L. HENDERSON is home from Canada.
Mr. C. E. KEEP is returning from Burma.
Mr. E. A. KODYEN has left Iraq and is now in Canada.
Mr. L. OWEN has left for Australia.
Mr. G. A. RICHARDS is returning to England from Sarawak.
Mr. H. N. SHER is home from the Canary Islands.

Correspondence or Journals forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address: C. T. BARBER, A. G. ENGELBACH, R. HARMAN, A. D. JONES, J. LANDER, I. C. LOW, I. LUSTY, A. MACLEAN, S. NICOL, E. B. SANGSTER, F. J. SCHNEIDER, and H. G. SPEARPOINT.

"PETROLEUM TECHNOLOGY IN 1936"

The attention of members, who have not yet purchased *Petroleum Technology in 1936*, is drawn to the fact that they are entitled to obtain copies at half the published price. (See advertisement on p. viii).

The publication summarizes scientific and technical progress in the industry during 1936 and forms an invaluable work of reference for all technologists.

Copies of the corresponding publication covering the year 1935 are still available to members of the Institution at 3*s.* 6*d.* per copy (4*s.* 0*d.* post free).

NOTICES.

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Papers and Articles.—The Council invites Papers and Articles both for reading at Ordinary Meetings of the Institution and for publication in the *Journal*. All Papers, whether for reading or publication, will be submitted to a referee appointed by the Publication Committee.

The Institution has published a brochure "Instructions for the Guidance of Authors" containing details of recommended practice in the preparation of Papers for publication. Copies of this brochure will be supplied on request.

Pre-Prints.—Advance proofs of Papers to be read at Ordinary Meetings are generally available about a week before the Meeting. Members wishing to be supplied with these pre-prints are requested to notify the Secretary.

Abstracts.—Members and Journal Subscribers desirous of receiving the Abstracts printed on one side of the paper only, can be supplied with these at a charge of 10*s.* per annum per copy, payable in advance.

Issue of Journal.—Members whose subscription is not in arrear receive the *Journal* free of cost. A member whose subscription is not paid by March 31st of the year for which it is due is considered to be in arrear.

Changes of Address.—Members are requested to notify any change of address to the Secretary.

Benevolent Fund.—The Benevolent Fund is intended to aid necessitous persons who are or have been members of the Institution, and their dependent relatives.

The Fund is raised by voluntary annual subscriptions, donations, and bequests, and all contributions should be sent to the Secretary of the Institution at Aldine House, Bedford Street, London, W.C. 2. The Fund is administered by the Council through the Benevolent Fund Committee, and all applications in connection therewith must be made on a special form which can be obtained from the Secretary of the Institution.

Appointments Register.—A register of members requiring appointments is kept at the offices of the Institution, and every effort is made to assist members of the Institution in search of employment.

Members who desire their names and qualifications to be included in this register are requested to apply to the Secretary for the Form of Application for Registration, if they have not already done so. Members residing in the London area are asked, if possible, to return this Form in person and make themselves known, together with their requirements, to the Secretary. It is also requested that members should notify the Secretary immediately they have obtained an appointment.

In submitting names of candidates to prospective employers it is understood that the Institution accepts no responsibility and gives no guarantee.

Library.—The Institution's Library may be consulted between the hours of 9.30 a.m. and 5 p.m. daily. (Saturdays, 9.30 a.m. to 12 noon.)

INSTITUTION NOTES.

FEBRUARY 1938.

FORTHCOMING MEETINGS.

Monday, 28th February, 1938, at Burlington House, Piccadilly, W.1, at 8 p.m. Joint Meeting with the Society of Chemical Industry, Road and Building Materials Group.

Discussion on "The Ageing of Bituminous Materials."

Tuesday, 1st March, 1938, at the Institution of Civil Engineers, Great George Street, S.W.1, at 7 p.m. Joint Meeting with the Institution of Automobile Engineers and other Societies.

Essential Road Conditions Governing the Safety of Modern Traffic.

Road Planning:	Dr. T. Adams.
Road Construction:	C. Havard Humphreys.
Road Illumination:	L. J. Davies and G. S. Lucas.

Tuesday, 22nd March, 1938, at the Royal Society of Arts, John Street, Adelphi, W.C.2, at 5.30 p.m.

5.30 p.m. **Special General Meeting.**
6.0 p.m. **Annual General Meeting.**

Tuesday, 12th April, 1938, at the Royal Society of Arts, John Street, Adelphi, W.C.2, at 5.30 p.m.

Presidential Address by Lt.-Col. S. J. M. Auld, O.B.E., M.C., D.Sc.

6th–11th June, 1938, at Glasgow. **Conference on Oil Shale and Cannel Coal.**

STUDENTS' SECTION (LONDON BRANCH).

Wednesday, 1st March, 1938, at the Institution Offices, at 6.15 p.m.

Oil in War, R. M. Stainforth (Student).

Tuesday, 15th March, 1938, at the Institution Offices, at 6.15 p.m.

Shale Oil, C. A. Hinton (Student).

Thursday, 31st March, 1938. Joint Meeting with the Students' Section (Birmingham Branch) at Birmingham.

Afternoon: Visit to the Department of Oil Mining and Refining, Birmingham University.

Evening: Address by Prof. A. W. Nash: **Oil from Coal.**

NORTHERN BRANCH.

Wednesday, 16th March, 1938, at 7.0 p.m., at The Engineers' Club, 17 Albert Square, Manchester. Open Discussion on **The Value of this Session's Lectures to Salesmen and Technical Members.**

Annual General Meeting.

THIRD WORLD PETROLEUM CONGRESS.

A meeting of the Permanent Council of World Petroleum Congresses was held in Paris on January 22nd, 1938, under the Presidency of Colonel L. Pineau, President of the Council. Representatives of the following countries were present: Belgium, France, Germany, Great Britain, Holland, Roumania and the United States.

The Permanent Council unanimously accepted the invitation of the Deutsche Gesellschaft für Mineralölforschung, presented by Professor L. Ubbelohde, to hold the 3rd World Petroleum Congress in Berlin during the months of May or June, 1940. In accepting this invitation, the Permanent Council desires to record its appreciation of invitations which had also been received from organisations in the United States, Austria and Holland respectively, to hold the 3rd World Petroleum Congress in those countries.

The exact date of the 3rd World Petroleum Congress will be announced in due course. Consideration will be given to the dates of other international Congresses, which are being arranged to take place during 1940 in Berlin, London, Rome and elsewhere, so as to avoid any overlapping with the date of the 3rd World Petroleum Congress.

Professor L. Ubbelohde, as President of the Deutsche Gesellschaft für Mineralölforschung, will shortly proceed to the formation of the German Committee of Organization, which will assume responsibility for the arrangements of the 3rd World Petroleum Congress.

The President and members of the Permanent Council of World Petroleum Congresses are confident that, in entrusting the 3rd World Petroleum Congress to the Deutsche Gesellschaft für Mineralölforschung, its success is assured, and that the Congress of Berlin in 1940 will prove a worthy successor to the achievements of London in 1933 and of Paris in 1937.

NEW MEMBERS.

The following elections were made by the Council in accordance with the By-Laws, Section IV, para. 7, at the Council Meeting held on the 8th February, 1938.

Elections are subject to confirmation in accordance with the By-Laws, Section IV, paras. 9 and 10.

Members.

KEMNITZER, William Johnson	California.
MANDELSTAM, Leopold Herman	London.

Associate Member.

MILLER, Thomas Albert	Bahrein Island.

As transfer to Associate Member.

BARRETT, Geoffrey Melvin	Meopham.

Students.

BALFOUR, Nicholas Robert	London.
ETESSAM, Abdol H.	Birmingham.
GRAY, Robert	London.
HORNE, Alan Bransby	Birmingham.
MINA, Heshmat	Birmingham.
MOAZAMI, Seifollah	Birmingham.
MOSTOFI, Baghis	Birmingham.
WELLINGS, Charles Edward	Birmingham.

Associate.

REID John William	London.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until after the lapse of at least one month subsequent to the issue of this Journal, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in each case.

BAGGS, James Milton, Student (*Colorado School of Mines*), P.O. Box No. 2, Golden, Colorado, U.S.A. (*R. A. Baxter; P. C. Dixon.*)

BAILEY, Bertrand Dexter, Chemical Engineer (*Foster Wheeler, Ltd.*), 41, Brodrick Road, London, S.W.17. (*A. W. Nash; A. S. Bridgwater*) (*Trans. from Student.*)

BELL, Colin Tait, Mechanical Engineer (*Royal Air Force*), 16, Prebend Mansions, High Road, Chiswick, W.4. (*G. W. Lepper; B. J. Ellis.*)

BURWELL, Arthur Warner, Chemist (*Alox Corporation*), P.O. Box 556, Niagara Falls, N.Y., U.S.A. (*A. E. Miller; E. G. Borden.*)

DEWHURST, John Desmond, Student (*Royal School of Mines*), 184, West Hill, Putney, S.W.15. (*V. C. Illing.*)

HUNN, Stanley A. H., Chemical Engineer (*Eagle Oil & Shipping Co., Ltd.*), 34, Hepworth Road, Streatham, S.W. 16. (*R. G. Mitchell; J. S. Jackson.*)

LEHNER, Hans Peter Ernst, Student (*Royal School of Mines*), 20, Linden Gardens, W.2. (*V. C. Illing.*)

MASTERSON, Edward Charles, General Manager ("*Unirea*" *S.A.R. de Petrol*), 27, Strada Caragiala, Ploesti, Roumania. (*G. Elias; E. Boaden*) (*Trans. from A.M.*)

MCDERMOTT, Lionel Roy, Student (*Royal School of Mines*), Rowanmore, 70, Edwin Road, Rainham, Kent. (*V. C. Illing.*)

MCLAUGHLIN, Michael Luckyn, Chemist (*Anglo-American Oil Co.*), "Woodcote," 47, Chestnut Avenue, Ewell, Surrey. (*H. C. Tett; C. Chilvers.*)

MURRAY, Alexander Frederick, Chemist, c/o Anglo-American Oil Co., Ltd., 83, Albert Embankment, S.E. 11. (*H. C. Tett; E. B. Evans.*)

PLASKOW, Cyril Selig, Clerk (*Shell-Mex & B.P., Ltd.*), 4, Winton Avenue, Westcliff-on-Sea. (*R. J. Bressey; A. W. Jarman.*)

SMITH, Arthur Frederick Philip, Chemist (*Shell Marketing Co., Ltd.*), 2, St. Andrew's Road, Enfield, Middlesex. (*J. S. Jackson; J. Parrish.*)

SMITS, Johannes Antonius, Mechanical Engineer (*Bataafsche Petroleum Mij.*), 46, van Beverningkstraat, The Hague, Holland. (*J. Chaillet; H. de Wilde.*)

STEPHENSON, Arthur Harold, Engineer (*Shell-Mex & B.P., Ltd.*), Installation Dept. Shell-Mex House, Victoria Embankment, W.C. 2. (*A. E. Hope; A. Harland.*)

VARLEY, John Hopwood, Manager (*Cork Harbour Oil Wharves*), Chowl House, Haulbowline Island, Co. Cork, Eire. (*A. T. Beazley; W. Groundwater*) (*Trans. from A.M.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

BRANCH NOTES.

Trinidad Branch.

The Annual General Meeting of the Trinidad Branch was held on 1st December, 1937.

Mr. J. Lonsdale Harris, B.Sc., A.R.C.Sc., M.Inst.P.T., was elected Chairman of the Branch for the ensuing session.

Mr. W. N. Foster, M.A. (Petroleum Office, San Fernando, Trinidad, B.W.I.), was elected Honorary Secretary of the Branch. Mr. H. C. H. Thomas, M.A., and Mr. F. L. Melvill, B.Sc., were elected members of the Committee.

The Annual General Meeting was followed by an ordinary meeting of the Branch, at which Mr. A. Newton read a paper entitled "Accelerated Oxidation as a Control Test in the Acid Treatment of Cracked Gasoline."

South Wales Branch.

"The improvement by cracking processes of Fischer-Tropsch Coal Spirit" was the subject of a paper by Mr. M. Perrin, delivered in Swansea on Friday, 7th January. The meeting was held under the auspices of the South Wales Branch of the Institution, in association with other local scientific societies.

WORLD POWER CONFERENCE.

Vienna Sectional Meeting.

A Sectional Meeting of the World Power Conference is to be held at Vienna from 25th August to 2nd September, 1938. The Papers and discussions will deal with the "supply of energy for agriculture, small-scale industries, household purposes, public lighting and electric railways."

Two Papers will be presented to the Vienna Sectional meeting sponsored by the Institution of Petroleum Technologists, viz :—

"Petroleum Fuels for Small-scale Industries," by P. H. Hering (Engine research branch, Anglo-Iranian Oil Co.) and H. F. Jones (International Association—Petroleum Industry—Ltd.); and

"Petroleum Fuels in Relation to Agriculture," by K. H. Sambrook and D. H. Meijnen (Asiatic Petroleum Co.).

PERSONAL NOTES.

Mr. H. N. Bassett has left Egypt and is now in Argentina.

Mr. C. Dalley is visiting Trinidad.

Mr. C. Gourlay is home from Burma.

Mr. L. F. Hooper has left for Iran.

Mr. A. P. Lieser is in U.S.A.

Mr. E. R. Palmer has left for Iran.

Mr. A. W. H. Phelps is home from Ceylon.

Mr. J. G. A. Roe is in Trinidad.

Correspondence or Journals forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address: C. T. Barber, R. Harman, A. D. Jones, J. Lander, I. C. Low, I. Lusty, Dr. H. G. Kugler, A. MacLean, R. L. Murray, F. J. Schneider, and H. G. Spearpoint.

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Venezuela, Trinidad.—P. Bayle, Villa Proselec, MARACAIBO, Venezuela.

Local Offices: San Fernando (Trinidad).

Argentina.—G. Guichardot, Schlumberger Electrical Coring, COMODORO RIVADAVIA, Km. 27.

Morocco.—M. Laubé, Société de Prospection Electrique, Petitjean, Morocco.

British India, Dutch East Indies.—R. Sauvage, KHODAUNG (Burma), DIGBOI (Assam), PLADJOE (Sumatra).

Rumania.—A. Poirault, 18, Strada Bratianu, CAMPINA (Prahova).

Germany.—Von Flotow, Wallebrechtstrasse 35, HANOVER, Germany.

U.S.S.R.—V. Melikian, Koptielsky pereoulok, dom No 9, kvartira 122, MOSCOW.

Austria.—O. Barbey, Sandgasse 26, VIENNA.

Poland.—P. Vincens, c/o Mr. Przybylowicz, Sykstuska 43 D, Lwow.

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INSTITUTION NOTES.

MARCH 1938.

FORTHCOMING MEETINGS.

Tuesday, 12th April, 1938, at the Royal Society of Arts, John Street, Adelphi, W.C.2, at 5.30 p.m.

Presidential Address by Lt.-Col. S. J. M. Auld, O.B.E., M.C., D.Sc.

6th–11th June, 1938, at Glasgow. **Conference on Oil Shale and Cannel Coal.**

Thursday, 7th April, 1938 (by invitation of the Institute of Fuel). **"The Manufacture of Coal Gas from Fuel Oil,"** by G. M. Gill and Leon Jones, at 6.0 p.m., at the Junior Institution of Engineers (First Floor), 39, Victoria Street, London, S.W.1. Advance copies of the Paper are obtainable from the Secretary.

STUDENTS' SECTION (LONDON BRANCH).

Wednesday, 13th April, at the Institution Offices, at 6.15 p.m.
Debate: **"Steam v. The Internal Combustion Engine."**

Tuesday, 26th April, at the Institution Offices, at 6.15 p.m.
"Distillation," by R. H. Keach (Student).

NEW MEMBERS.

The following elections were made by the Council in accordance with the By-Laws, Section IV, para. 7, at the Council Meeting held on the 22nd March, 1938.

Elections are subject to confirmation in accordance with the By-Laws, Section IV, paras. 9 and 10.

Members.

ENGEL, Bruno	Stockholm.
KIDD, Thomas George	London.
MANDELBAUM, Malvin R.	New York.
STANLEY, George Arthur Vickers	Sydney.
VASCHALDE, André	Paris.

As transfer to Member.

DRIVER, Percival	London.

Associate Members.

BOSHELL, Ernest Gerard	Iran.
COLLCOTT, John Sanders	Trinidad.
OWEN, Albert Arthur George	Egypt.
WATLING, Reginald Albert	London.

Student.

BARTLEY, Edward Brian	London.

Associate.

HOGGAN, Vivian Glen Ewart	Central India.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until after the lapse of at least one month subsequent to the issue of this *Journal*, during which any Member or Associate Member may communicate by letter to the Secretary for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

BOERLAGE, Gerrit Daniel, Director, Delft Laboratory (*Bataafsche Petroleum Mij.*), Proefstation "Delft," Haagweg 126, Delft, Holland. (*J. Kewley; A. E. Dunstan.*)

BROWNE, Donald Wheeler, Chemist (*Royal Air Force*), 24, Eltham Hill, Eltham, S.E.9. (*G. M. Dyson; C. W. Tordiffe.*)

BUTLER, John Manton, Chemist (*Asiatic Petroleum Co.*), St. Helens Court, Great St. Helens, E.C.3. (*J. Kewley; W. W. Goulston.*)

COLES, Peter Jack, Trainee (*Asiatic Petroleum Co.*), 37, Mill Road, West Worthing, Sussex. (*J. Kewley; W. W. Goulston.*)

DRURY, Kenneth George, Examiner (*A.I.D.*), 7, Woodstock Road, Redland, Bristol. (*E. M. Shipman; C. W. Tordiffe.*)

EVANS-JONES, Emyr, Engineer (*Anglo-American Oil Co.*), 158, Princes Gardens, London, W.3. (*D. S. Paul; H. C. Tett.*)

HOOK, Douglas Lawson, Chemist (*Shell Co. of Australia*), "St. Martins," 30, Cremorne Road, Cremorne, Sydney, N.S.W. (*T. M. Hartigan; D. Fell.*)

KERRY, Robert Macdonald, Chemist (*British Bitumen Emulsion Ltd.*), 79, Dollis Park, Church End, Finchley, N.3. (*I. Cameron; F. H. Garner.*)

LANNING, Charles Edward, Chemist (*Standard Oil Co. of New Jersey*), 5/6, Brettenham House, London, W.C.2. (*F. H. Garner; A. Osborn.*)

OGSTON, Alexander Robert, Assistant Technical Supervisor (*International Aviation Associates*), 6, St. Margarets Court, Brighton, 1. (*C. W. Wood; F. R. Banks.*) (Transfer from A.M.)

REHBEIN, Charles Augustus, Chemist, Naval Research Laboratory, Anacostia Station, Washington, D.C., U.S.A. (*R. B. High; F. L. Garton.*)

WEATHERUP, Frank John, Chemist (*Anglo-American Oil Co.*), 105, Rectory Lane, Tooting, London, S.W.17. (*H. C. Tett; E. B. Evans.*)

WHALLEY, William C. R., Chemical Engineer (*Iraq Petroleum Co., Ltd.*), 52, Annandale Road, Greenwich, S.E.10. (*S. J. Ireland; A. W. Scivyer.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Mr. R. A. BALDRY has left for Peru.

Mr. H. A. HARRIS is home from Trinidad.

Dr. W. HOPE HENDERSON has left for South Africa.

Mr. T. SPEIGHT is returning to England from Burma.

Correspondence or *Journals* forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address: L. GOWER, R. HARMAN, A. D. JONES, Dr. H. G. KUGLER, J. LANDER, I. C. LOW, I. LUSTY, A. MACLEAN, R. L. MURRAY, S. NICOL, M. I. OREVICEANU, F. J. SCHNEIDER and H. G. SPEARPOINT.

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Morocco.—M. Laubé, Société de Prospection Electrique, Petitjean, Morocco.

British India, Dutch East Indies.—R. Sauvage, KHODAUNG (Burma), DIGBOI (Assam), PLADJOE (Sumatra).

Rumania.—A. Poirault, 18, Strada Bratianu, CAMPINA (Prahova).

Germany.—Von Flotow, Wallebrechtstrasse 35, HANOVER, Germany.

U.S.S.R.—V. Melikian, Koptielsky pereoulok, dom № 9, kvartira 122, Moscow.

Austria.—O. Barbey, Sandgasse 26, VIENNA.

Poland.—P. Vincens, c/o Mr. Przybylowicz, Sykstuska 43 D, LWOW.

NOTICES.

The Institution as a body is not responsible for the statements of opinion expressed in any of its publications.

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The Institution has published a brochure "Instructions for the Guidance of Authors" containing details of recommended practice in the preparation of Papers for publication. Copies of this brochure will be supplied on request.

Pre-Prints.—Advance proofs of Papers to be read at Ordinary Meetings are generally available about a week before the Meeting. Members wishing to be supplied with these pre-prints are requested to notify the Secretary.

Abstracts.—Members and Journal Subscribers desirous of receiving the Abstracts printed on one side of the paper only, can be supplied with these at a charge of 10*s*. per annum per copy, payable in advance.

Issue of Journal.—Members whose subscription is not in arrear receive the *Journal* free of cost. A member whose subscription is not paid by March 31st of the year for which it is due is considered to be in arrear.

Changes of Address.—Members are requested to notify any change of address to the Secretary.

Benevolent Fund.—The Benevolent Fund is intended to aid necessitous persons who are or have been members of the Institution, and their dependent relatives.

The Fund is raised by voluntary annual subscriptions, donations, and bequests, and all contributions should be sent to the Secretary of the Institution at Aldine House, Bedford Street, London, W.C. 2. The Fund is administered by the Council through the Benevolent Fund Committee, and all applications in connection therewith must be made on a special form which can be obtained from the Secretary of the Institution.

Appointments Register.—A register of members requiring appointments is kept at the offices of the Institution, and every effort is made to assist members of the Institution in search of employment.

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In submitting names of candidates to prospective employers it is understood that the Institution accepts no responsibility and gives no guarantee.

Library.—The Institution's Library may be consulted between the hours of 9.30 a.m. and 5 p.m. daily. (Saturdays, 9.30 a.m. to 12 noon.)

INSTITUTION NOTES.

APRIL 1938.

THE REDWOOD MEDAL.

The Council has much pleasure in announcing that the Redwood Medal of the Institution has been awarded to Dr. A. E. Dunstan in recognition of his distinguished services to the science and technology of petroleum.

The conditions of award of the Redwood Medal are that it shall be awarded "not more than once in each year, to a petroleum technologist of outstanding eminence, irrespective of nationality or membership of the Institution." Under these conditions, the Redwood Medal has been awarded on three occasions, viz., 1932, Dr. L. Edeleanu; 1934, Dr. David White; 1936, Mr. Harry Ricardo.

The presentation of the Redwood Medal to Dr. Dunstan was made by the President at a meeting in London on 12th April. A report of the proceedings at this meeting will be given in the May issue of the Journal.

SPECIAL GENERAL MEETING.

The Resolutions contained in the documents dated 21st February and 28th February respectively, and circularised to all members of the Institution, were adopted as Special Resolutions at the Special General Meeting held in London on 22nd March, 1938.

The change in the name of the Institution to the "Institute of Petroleum" will not become operative until authority has been received from the Board of Trade.

FORTHCOMING MEETING

Tuesday, 10th May, 1938, at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, at 5.30 p.m.

"Deterioration of Lubricating Oils in the Automobile Engine," by Prof. Henri Weiss (*École Supérieure du Pétrole, Strasbourg*).

ELECTIONS TO COUNCIL.

The following Members were elected members of Council as a result of the Ballot declared at the Annual General Meeting:

A. FRANK DABELL, M.I.Mech.E.
Prof. V. C. ILLING, M.A., M.Inst.M.M.
Dr. E. R. REDGROVE, Ph.D., B.Sc., F.C.S.
W. J. WILSON, F.I.C., F.C.G.I.
CECIL W. WOOD, F.I.C.

ANNUAL GENERAL MEETING.

The report of the proceedings at the Special General Meeting and the Annual General Meeting will be published in the May issue of the *Journal*. This issue will also include the Annual Reports of the Branches and the Presidential Address of Lt.-Col. S. J. M. Auld.

REPRESENTATION ON OTHER BODIES.

Rubber Technology Conference. Dr. F. B. THOLE and Mr. W. E. GOODAY have been appointed to represent the Institution at a Rubber Technology Conference to be held in London from 23rd to 25th May, under the auspices of the Institution of the Rubber Industry. Particulars of the Conference are obtainable from the Secretary, The Institution of the Rubber Industry, 12 Whitehall, London, S.W.1.

Diesel Engine Users Association. Mr. L. J. LE MESURIER and Mr. N. MITCHELL represented the Institution at a meeting of the Diesel Engine Users Association on 7th April, when the Annual Bulletin of Developments in Diesel Engineering was presented.

Institute of Fuel. Dr. A. E. DUNSTAN has been appointed the representative of the Institution of Petroleum Technologists on the Council of the Institute of Fuel.

SCOTTISH CONFERENCE.

Particulars of the Conference on Oil Shale and Cannel Coal, to be held in Glasgow from 6th to 11th June, have been sent to all members of the Institution. An extremely interesting programme of technical papers, works visits and social functions has been arranged. Over 200 registrations have already been received. The Council hopes that as many members of the Institution as possible will support this meeting in Glasgow and, if they contemplate visiting the Empire Exhibition this summer, to make their visit coincide with the period of the Conference at Whitsuntide.

Members who intend to be present are asked to forward their Registration Forms without delay, in order to facilitate the work of organization.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until the lapse of at least one month subsequent to the issue of this *Journal*, during

which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in parentheses.

BROOM, William Edward John, Technical Department, Anglo-American Oil Co., Ltd., 80, Albert Palace Mansions, S.W.11. (*Trans. from A.M.*). (*H. C. Tett ; F. H. Garner.*)

BULMAN, Llewelyn Noel, Geologist (*Specialised Aggregates Ltd.*), 15 Park Hill Road, Harborne, Birmingham. (*A. W. Nash ; L. V. W. Clark.*)

CRUMLEY, Richard G., Chemical Engineer (Conewango Refining Co.), 115, Fifth Avenue, Warren, Penna., U.S.A.

DEE, Thomas William Hamilton, Field Superintendent, Oil Search Ltd., 350 George Street, Sydney, N.S.W. (*A. Wade.*)

HENRY, Arthur George John Dunstan, Distillation Operator, c/o Anglo-Iranian Oil Co., Ltd., Abadan, S. Iran. (*A. Reid ; G. E. Wheeler*).

HORIE, Fukio, Director and Chief Engineer, c/o Japan Gasoline Co., Osaka Building, Uchisaiwaiche, Kojimachi-Ku, Japan. (*P. E. Joyce ; H. Woodfield.*)

JEWELL, John Christopher, Chemist, c/o Anglo-Iranian Oil Co., Ltd., Kermanshah, Iran. (*R. G. Brown ; A. Reid.*)

KIERNAN, Herbert Stephen, Chemist, London Oil Refining Co., Manchester (*Trans. from Student*). (*J. E. Haslam ; C. E. Burnett.*)

MCCULLOCH, Andrew, University Lecturer, c/o College of Technology, Manchester, 1 (*J. E. Bennion ; A. E. Dunstan.*)

TATTERSALL, Cecil Owen, Assistant Chief Inspector, Indian Ordnance Services, Cawnpore, India.

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Mr. H. G. BUSK is home from Argentina.

Mr. D. G. BUTLIN has returned to Argentina.

Mr. R. HARMAN has returned from Roumania.

Mr. M. E. KELLY has returned to Iran.

Mr. A. M. WYLIE is home from Argentina.

Correspondence or *Journals* forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address: J. L. BLACK, L. GOWER, A. D. JONES, Dr. H. G. KUGLER, J. LANDER, I. C. LOW, I. LUSTY, A. MACLEAN, R. L. MURRAY, S. NICOL, M. I. OREVICEANU, T. W. ROBINSON, F. J. SCHNEIDER and H. G. SPEARPOINT.

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INSTITUTE NOTES

MAY 1938.

THE INSTITUTE OF PETROLEUM.

The Special Resolution passed by the members at the Special General Meeting on 22nd March, 1938: "That the name of the Institution be changed to The Institute of Petroleum" has received the approval of the Board of Trade and has been filed with the Registrar of Companies. The change of name is effective as from 14th April, 1938.

REGISTRATION OF MEMBERSHIP.

In accordance with Article 2 of the Articles of Association and pursuant to Section 7 (3) of the Companies Act, 1939, the total number of members of the Institute for purposes of registration has been increased from 2000 to 4000.

NEW MEMBERS.

The following elections were made by the Council in accordance with the By-Laws, Section IV, para. 7, at the Council Meeting held on Thursday, 5th May, 1938.

Elections are subject to confirmation in accordance with the By-Laws, Section IV, paras. 9 and 10.

Members.

BELL, Colin Tait	London.
BURWELL, Arthur Warner	New York.
MURRAY, Alexander Frederick	London.
STEPHENSON, Arthur Harold	London.

Transfer to Members.

MASTERSON, Edward Charles	Roumania.
VARLEY, John Hopwood	Cork.

Associate Members.

HUNN, Stanley A. H.	London.
SMITH, Arthur Frederick Philip	London.
SMITS, Johannes Antonius	The Hague.

Transfer to Associate Member.

BAILEY, Bertrand Dexter	London.

Students.

BAGGS, James Milton	Colorado.
DEWHURST, John Desmond	London.
LEHNER, Hans Peter Ernst	London.
MCDERMOTT, Lionel Roy	Rainham.
MCLAUGHLIN, Michael Luckyn	Ewell.
PLASKOW, Cyril Selif	Westcliff-on-Sea.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institute or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until the lapse of at least one month subsequent to the issue of this *Journal*, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in parentheses.

BINLEY, Kenneth Aubrey Edward, Control Operator, c/o Anglo-Iranian Oil Co., Ltd., Haft Kel, S. Iran. (*R. H. Stuttle ; C. V. Rutherford.*)

CLAYTON, David, Engineer, c/o Engineering Dept., National Physical Laboratory, Teddington, Middx. (*S. J. M. Auld ; F. H. Garner.*)

COGAN, Myles Honohan Resuggan, Engineer, c/o Anglo-Saxon Petroleum Co., Ltd., St. Helens Court, E.C.3. (*E. le Q. Herbert ; W. C. Webber.*)

HALE, Richard, Driller (*Anglo-Iranian Oil Co.*), 275, Neasden Lane, London, N.W.10. (*Ashley Carter ; F. E. Cherry.*)

HARRIS, Norman, Student (*Vacuum Oil Co., Ltd.*), 53, Fountayne Road, Stoke Newington, N.16. (*S. J. M. Auld ; N. Gullick.*)

HAZZARD, Geoffrey Francis, Chemist, c/o Arend Petroleum Mij, Aruba, D.W.I. (*P. Meyer ; J. S. Jackson*) (*Transfer from Student*).

HUBBARD, Austin Walter, Director, Combustions Ltd., 37, Walbrook, London, E.C.4. (*R. Lessing ; C. W. Wood.*)

MELVILLE, Leonard, Chemical Engineer, c/o Anglo-Iranian Oil Co., Ltd., Abadan, S. Iran. (*H. W. Rigden ; Alex. Reid.*)

MCKILLOP, Lambert Llewellyn, Field Superintendent (*Oil Search Ltd.*), 350, George Street, Sydney, N.S.W. (*A. Wade ; F. E. Cherry.*)

NOERRING, Otto, Chemist, Rhenania-Ossag Mineralolwerke A.G. Werk Brasbrook, Hamburg 8. (*J. F. Reydon ; G. Voogt.*)

READ, Cecil William Millidge, Engineer (*Edgar Vaughan & Co.*), Mariemont, Westbourne Road, Edgbaston. (*A. Nash ; L. U. W. Clark*) (*Transfer from Student*).

ROBINSON, Arthur Wilson, Local Manager (*Anglo-American Oil Co.*), Glenside 65, Lexden Road, Colchester. (*H. C. Tett ; C. Chilvers.*)

SQUIRE, Edward Samuel, Chemist, National Oil Refineries Ltd., Llandarcy, Neath, S. Wales. (*W. C. Mitchell ; A. E. Dunstan.*)

VARTERESSIAN, Kegham A., Chemical Engineer (*Pennsylvania State College*), University Club, State College, Pa., U.S.A. (*M. R. Fenske ; C. R. Wagner.*)

WATSON, Herbert Barry, Trainee (*Anglo-Saxon Petroleum Co.*), c/o Lloyds Bank Ltd., F. Branch, 6, Pall Mall, S.W.1. (*J. Kewley ; W. W. Goulston.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Mr. H. B. BORWICK is home on leave from Australia.

Mr. D. GLYNN JONES has returned from Iraq.

Dr. H. G. KUGLER is in Trinidad.

Mr. M. P. MCCARTHY is home on leave from India.

Mr. F. G. RAPPOPORT is home from Venezuela.

Mr. F. S. SMITH is home from Mexico.

Mr. G. STEVENSON has left Iran and is now in England.

Correspondence or Journals forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address : J. C. BLACK, L. GOWER, A. E. JARRETT, A. D. JONES, J. LANDER, I. C. LOW, I. LUSTY, A. MACLEAN, R. L. MURRAY, S. NICOL, M. I. OREVICEANU, T. W. ROBINSON, F. J. SCHNEIDER and H. G. SPEARPOINT.

INSTITUTE NOTES.

JUNE, 1938

BRANCH NOTES.

The Council of the Institute has agreed to present a Branch Prize to the value of £3 3*s*. in books or apparatus to the Branch Member who, in the opinion of the Branch Committee, has done the most in each year to foster the development of the Branch.

The first awards of this Prize have been made to:—

Mr. E. J. HORLEY, South Wales Branch.

Mr. J. E. BENNION, Northern Branch.

BURMA BRANCH.

The Branch Committee for 1938 was elected at the Annual General Meeting of the Burma Branch held on 7th April, at the Volunteer Club, Yenangyaung. The new committee consists of

Mr. R. HARCUS (Chairman).

Mr. C. A. SANSAM (Deputy Chairman).

Mr. A. REID (Honorary Secretary and Treasurer).

Mr. J. L. BENARD.

Mr. H. C. CARTER.

Mr. W. R. S. HENDERSON.

Mr. P. JESSOP.

Mr. J. S. PIRIE.

Mr. J. RANKINE.

Mr. H. R. TAINSH.

Three meetings were arranged for May, June and July.

IRANIAN BRANCH.

A Meeting of the Iranian Branch was held at the Annexe of the Abadan Gymkhana Club on April 12th, when Mr. A. Donald Green presented a paper on the structure of metals and alloys. An interesting feature of the paper was a collection of photographs showing the points of maximum stress along a shaft and hub. These are developments of very recent date and, as it was pointed out, of the greatest promise in the elucidation of the points of maximum stress in such complicated structures as "Headers" used in pipe-stills.

The next meeting of the Branch will probably be held in early November.

CANDIDATES FOR ADMISSION.

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The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in parentheses.

AICKIN, Robert Geoffrey, Research Chemist (*Shell Co. of Australia Ltd.*), 35 Aivone Road, Caulfield, Victoria, Australia. (*T. M. Hartigan ; J. Kewley.*)

DICKINSON, George, Exploitation Engineer, c/o Caribbean Petroleum Co., Maracaibo, Venezuela. (*H. O. Watson*) ; (*Transfer from Associate Member.*)

HARRISON, John Alfred, Metallurgist, c/o The Daimler Co., Coventry. (*C. W. B. Short ; A. E. Jarrett.*)

MACDONALD, Hector Goring, Chemist (Anglo-American Oil Co., Ltd.), 8, Overtoun Road, Dalmuir, nr. Glasgow. (*H. C. Tett ; E. B. Evans.*)

METCALFE, James Vivian, Civil Engineer, Office of the City Water Engineer, P.O. Box 680, Durban, South Africa. (*V. L. Hope ; D. C. Broome.*)

ST. HILAIRE, Frank Desmond, Refinery Operator, c/o Trinidad Leaseholds Ltd., Pointe-a-Pierre, Trinidad. (*J. T. T. Robinson ; B. G. Banks.*)

YOUNG, Laurence McLellan, Student (*Cambridge University*), "Abbotsleigh," Bridge of Allan, Stirlingshire. (*A. Wood ; A. E. Dunstan*).

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Dr. A. WADE (Member of Council) has been appointed Chairman of the Oil Advisory Committee of the Commonwealth of Australia and Chief Executive Officer.

Mr. T. J. F. ARMSTRONG is home from Burma.

Lt.-Commdr. W. W. DOWNS is home on leave from Ceylon.

Dr. J. A. L. HENDERSON has gone to Canada for six months.

Mr. A. N. LUCIE-SMITH is home from Venezuela.

Mr. W. E. MADDEN has left Mexico, and is now in Venezuela.

Mr. D. N. MCKINLAY has returned to Iran.

Mr. G. P. MELVILLE is home from Burma.

Mr. F. E. WELLINGS has returned from Ceylon.

Correspondence or Journals forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address: J. C. BLACK, V. G. S. GEORGESCU, L. GOWER, A. E. JARRETT, A. D. JONES, J. LANDER, I. C. LOW, I. LUSTY, A. MACLEAN, T. A. MILLER, R. L. MURRAY, S. NICOL, M. I. OREVICEANU, T. W. ROBINSON, F. J. SCHNEIDER, H. G. SPEARPOINT and A. H. WILLIAMS.

INSTITUTE NOTES.

JULY 1938.

ALTERATIONS IN CONSTITUTION.

The approval of the Chancery Court was given on 30th May, 1938, to the changes in the Memorandum, Articles and By-Laws, passed by the members at the Special General Meeting on 22nd March, 1938. An office copy of the Order of the Court has been filed with the Registrar of Companies and the changes are effective as from 16th June, 1938.

NEW MEMBERS.

The following elections were made by the Council in accordance with the By-Laws, Section IV, para. 7, at the Council Meeting held on Tuesday, 19th July, 1938.

Elections are subject to confirmation in accordance with the By-Laws, Section IV, paras. 9 and 10.

Members.

CLAYTON, David	Teddington.
COGAN, Myles Honohan Resuggan	Curucao.
DEE, Thomas William Hamilton	Sydney.
EVANS-JONES, Emyr	London.
HALE, Richard	London.
HORIE, Fukio	Tokyo.
HUBBARD, Austin Walter	London.
LANCING, Charles Edward	London.
MCCULLOCH, Andrew	Manchester.
MCKILLOP, Lambert Llewellyn...	Sydney.
NOERRING, Otto	Hamburg.
REHBEIN, Charles Augustus	Washington.
SQUIRE, Edward Samuel	Neath.
VARTERESSIAN, Kegham A.	State College, Penna.

Transfer to Members.

BROOM, William Edwin John	London.
NABUCO DE ARAUJO, Jor. C. E.	Rio de Janeiro.
OGSTON, Alexander Robert	Brighton.

Associate Members.

BINLEY, Kenneth Aubrey Edward	South Iran.
BROWNE, Donald Wheeler	London.
BULMAN, Llewelyn Noel	Birmingham.
BUTLER, John Manton	London.
DRURY, Kenneth George	Bristol.
HARRIS, Norman	London.

Associate Members (contd.).

Henry, Arthur George John Dunstan	Abadan.
Hook, Douglas Lawson	Sydney.
Jewell, John Christopher	Iran.
Kerry, Robert Macdonald	London.
Melville, Leonard	Abadan.
Robinson, Arthur Wilson	Colchester.
Tattersall, Cecil Owen	Cawnpore.
Weatherup, Frank John	London.
Whalley, William C. R.	London.

Transfer to Associate Member.

Hazzard, Geoffrey Francis	Aruba.
Kiernan, Herbert Stephen	Manchester.
Read, Cecil William Millidge	Birmingham.

Students.

Coles, Peter Jack	Worthing.
Watson, Herbert Barry	London.

CANDIDATES FOR ADMISSION.

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The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in parentheses.

Dennis, Cyril Frederick, General Sales Manager, Messrs. W. B. Dick & Co., Ltd., 26 Grosvenor Gardens, London, S.W.1. (*C. Dalley ; A. E. Dunstan.*)

Ettlinger, Ernest Hjalmar, Chemical Engineer (*Cia. Mexicana de Petroleo "El Aguila" S.A.*), 106 Dorset House, Gloucester Place, London, N.W.1. (*W. T. Jarrett ; E. L. Herbert.*) (*Transfer from Associate Member.*)

Hill, Dennis Stanley, Works Chemist (*Messrs. Carless, Capel & Leonard*), 9 Berkeley Avenue, Barkingside, Essex. (*S. J. M. Auld.*)

Neppe, Solly Louis, Research Chemist (*South African Torbanite Mining & Refining Co., Ltd.*), 127 Newlands Avenue, Benoni, Transvaal, South Africa. (*F. Stephenson.*)

Rayner, Cyril Kentish, Chemical Engineer, Anglo-Iranian Oil Co., Ltd., Abadan, South Iran. (*W. H. Thomas ; D. A. Howes.*)

Schiffman, Eric Charles, Refinery Operator, South African Torbanite Mining & Refining Co., Ltd., P.O. Box 499, Johannesburg, South Africa. (*F. Stephenson.*)

Waterford, Leo Mengersen, Field Superintendent, *Roma Blocks Oil Company*, Roma, Queensland, Australia. (*A. Wade.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

HADFIELD'S

TRADE ERA 131 MARK & TRADE HECLA 153 MARK

STEAM PIPE FLANGE BOLTS

HAVE A HIGH CREEP STRENGTH

For use at the highest temperature employed in modern steam practice.
Do not become brittle as a result of operating conditions.

Steel Castings and Forgings of all Kinds.

Area of Works over 200 acres **HADFIELDS LTD.** Buildings cover 61 acres

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SCHLUMBERGER ELECTRICAL CORING

France.—Société de Prospection Electrique, 30, rue Fabert, PARIS.

U.S.A.—Schlumberger Well Surveying Corporation, Esperson Building, HOUSTON, Texas.

Local Offices: Long Beach, Oklahoma City, New York, Corpus Christi, Bradford.

Venezuela, Trinidad.—P. Bayle, Villa Proselec, MARACAIBO, Venezuela.

Local Offices: San Fernando (Trinidad).

Argentina.—G. Guichardot, Schlumberger Electrical Coring, COMODORO RIVADAVIA, Km. 27.

Morocco.—M. Laubé, Société de Prospection Electrique, Petitjean, Morocco.

British India, Dutch East Indies.—R. Sauvage, KHODAUNG (Burma), DIGBOI (Assam), PLADJOE (Sumatra).

Rumania.—A. Poirault, 18, Strada Bratianu, CAMPINA (Prahova).

Germany.—Von Flotow, Wallebrechtstrasse 35, HANOVER, Germany.

U.S.S.R.—V. Melikian, Koptielsky pereoulok, dom No 9, kvartira 122, Moscow.

Austria.—O. Barbey, Sandgasse 26, VIENNA.

Poland.—P. Vincens, c/o Mr. Przybylowicz, Sykstuska 43 D, Lwow.

BRANCH NOTES.

Scottish Branch.

Advantage was taken of the recent Conference on Oil Shale and Cannel Coal in Glasgow to convene a meeting of members of the Institute residing in Scotland with the object of discussing the formation of a Scottish Branch.

The President (Col. S. J. M. Auld) presided over a meeting of some 30 or 40 members and other interested persons, convened in the Empire Exhibition, Glasgow, on Tuesday, 7th June. He was pleased to report that a number of letters had been received from members unable to attend, expressing their approval of the formation of a Scottish Branch. Sir John Cargill, a Founder-Member of the Institute, had welcomed the suggestion and promised his full support.

Mr. H. M. Macintyre proposed, and Dr. G. H. Smith seconded, and it was unanimously agreed that a Scottish Branch of the Institute be formed. It was also unanimously agreed that Mr. R. Crichton be the first Chairman of the Branch, and that Professor W. M. Cumming be the first Honorary Secretary of the Branch.

Members and others resident in Scotland desirous of receiving information regarding the Branch should communicate with Prof. W. M. Cumming, D.Sc., F.I.C., The Royal Technical College, Glasgow.

PERSONAL NOTES.

Mr. A. E. Day is home from Burma.
Mr. J. Kay is home on leave from Burma.
Mr. W. J. Kemnitzer is returning from U.S.A.
Mr. R. H. Mitchell is returning from Burma.
Mr. E. N. Tiratsoo is now in Iraq.
Mr. J. Westbury is home from Trinidad.
Mr. H. Woodfield is on his way to Australia.

Correspondence or *Journals* forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address: J. L. Black, V. C. S. Georgescu, L. Gower, J. Haker, A. E. Jarrett, A. D. Jones, J. Lander, I. Lusty, A. MacLean, T. A. Miller, R. L. Murray, S. Nicol, M. I. Oreviceanu, T. W. S. Robinson, F. J. Schneider, H. G. Spearpoint, and A. H. Williams.

Journals Wanted to Purchase.

The Institute is prepared to purchase copies of the following *Journals* at the prices given.

No. 171 (January, 1938)	4*s.* 0*d.*
„ 172 (February, 1938)	4*s.* 0*d.*
„ 173 (March, 1938)	4*s.* 0*d*

Copies should be forwarded to the Secretary.

INSTITUTE NOTES.

AUGUST 1938.

FORTHCOMING MEETINGS.

Tuesday, 11th October, 1938, at 5.30 p.m., at the Royal Society of Arts, John Street, Adelphi, London, W.C.2.

"Cutting Oils and Machinery."

A series of Papers will be presented.

Further particulars will be included in the September *Journal*.

Monday, 12th December, 1938, **Annual Dinner of the Institute,** at Grosvenor House, Park Lane, London, W.1.

NORTHERN BRANCH

Thursday, 6th October, 1938. **"The Application of Recent Chemical Research to the Improvement of Petroleum Products,"** by F. B. Thole, D.Sc., F.I.C., F.C.S.

Thursday, 3rd November, 1938. **"Industrial Greases,"** by R. McDonald, B.Sc.

Thursday, 8th December, 1938. **"Light Oil for Automobile Engines,"** by C. G. Williams, M.Sc.

Thursday, 5th January, 1939. **"Modern Methods Applied to the Manufacture of Lubricating Oils,"** by E. J. Dunstan, M.Sc.

Thursday, 9th February, 1939. **"What Happens to Motor Oil and What Happens to the Engines,"** by C. I. Kelly, M.Sc.(Tech.), F.I.C., F.C.S.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institute or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until the lapse of at least one month subsequent to the issue of this *Journal*, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in parentheses.

ANDREW, Frank, Director (*London Oil Refining Co.*), "The Nook," Bramhall Park, Cheadle Hulme, Cheshire. (*J. E. Haslam ; H. S. Kiernan.*)

COOPER, Stanley Charles Richard, Engineer, Soc. "Unirea" Casuta Postala No. 1, Ploesti, Roumania. (*E. J. Sole ; O. A. Bell.*)

DARBYSHIRE, Sydney, Plant Operator, Anglo-Iranian Oil Co., Ltd., Abadan, Iran. (*B. D. Cauthery ; J. E. Ford.*)

EMERY, Douglas John, Assistant Chemist (L.N.E.R.), "Langford," 96, King's Avenue, Woodford Green, Essex. (*S. J. M. Auld ; N. G. Gullick.*)

FARQUHARSON, Douglas Ian, General Manager, United British Oilfields of Trinidad, Point Fortin, Trinidad. (*A. J. Ruthven-Murray ; M. A. ap. Rhys-Pryce.*)

MYHILL, Walter Edward, Clerk (*Phœnix Oil Products, Ltd.*), Strada Gen. Berthelot No. 90, Bucarest, Roumania. (*T. S. Masterson ; E. Boaden.*)

NEWBY, William John, Chemist, Anglo-Iranian Oil Co., Ltd., Abadan, Iran. (*D. H. Howe ; W. H. Thomas.*)

PRIEST, Ernest Horace, Engineer (*Wilton's Patent Furnace Co., Ltd.*), 15, Queen's Drive, Tolworth, Surrey. (*F. E. Cherry ; R. Sefton.*)

TANAKA, Yoshio, Chemist, Department of Applied Chemistry, Faculty of Engineering, Tokyo Imperial University, Tokyo. (*P. E. Joyce; J. Kewley.*)

TAYLOR, John Leslie, Chemist, Anglo-American Oil Co., Ltd., 83, Albert Embankment, S.E.11. (*Trans. from A.M.*) (*H. C. Tett; F. H. Garner.*)

TRIM, Frederick Aine, Engineer (*Universal Oil Products, Ltd.*), 24, Elmfield Road, London, S.W.17. (Trans. from A.M.) (*V. Henny; W. A. Keightley.*)

DE WAELE, John Pierre Armand, Engineer Trainee (*Anglo-Iranian Oil Co., Ltd.*), "Silverdale," Eversley Crescent, N.21. (*A. E. Dunstan; A. C. Hartley.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

ANNUAL REVIEWS OF PETROLEUM TECHNOLOGY, VOLUME III.

Volume III of the Annual Reviews of Petroleum Technology has now been published. Members are reminded that they may purchase copies of this book at 5*s.* 6*d.*, post free. The price to non-members is 11*s.*, post free.

PERSONAL NOTES.

Lt.-Col. S. J. M. AULD, Dr. A. E. DUNSTAN and Mr. J. KEWLEY have been elected Honorary Members of the D.2 Committee of the American Society for Testing Materials.

Prof. Dr. L. UBBELOHDE has been elected an Honorary Member of the Akademie der Wissenschaften in Bucharest.

Ing. JAN MARTYNIK has been appointed Honorary Colonel of Royal Engineers by the King of Yemen.

Mr. W. E. GOODAY, Member of Council, has left for South Africa.

Mr. J. L. BLACK is in Sarawak.

Mr. I. C. LOW is now in South Iran.

Mr. G. J. MALHERBE has left for U.S.A.

Correspondence or *Journals* forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address: V. C. S. GEORGESCU, L. GOWER, J. HAKER, A. D. JONES, J. LANDER, I. LUSTY, A. MACLEAN, R. L. MURRAY, S. NICOL, M. I. OREVICEANU, F. J. SCHNEIDER, H. G. SPEARPOINT, and A. H. WILLIAMS.

Journals Wanted to Purchase.

The Institute is prepared to purchase copies of the following *Journals* at the prices given.

No. 147 (January, 1936)	4*s.* 0*d.*
,, 149 (March, 1936)	4*s.* 0*d.*

Copies should be forwarded to the Secretary.

INSTITUTE NOTES.

SEPTEMBER, 1938.

CHANGE OF ADDRESS.

On and after 1st October, 1938, the address of the Institute will be :

The Institute of Petroleum,
The Adelphi,
London, W.C.2.

The telephone number will remain as at present (viz. Temple Bar 1842).

The new premises are situated on the sixth floor of the new Adelphi building, in the N.W. block. The entrance to the Adelphi faces the Royal Society of Arts in Duke Street (formerly John Street), W.C.2.

FORTHCOMING MEETINGS.

Tuesday, 11th October, 1938, at 5.30 p.m. at the Royal Society of Arts, Duke Street, W.C.2.

"Cutting Oils and Machinery."

"The Manufacture of Cutting Oils," by J. F. Miller (*Messrs. Fletcher, Miller, Ltd.*)

"Cutting Fluids and the Machine Tool," by A. H. Lloyd, B.Sc., M.I.Mech.E., and H. Beeny (*Messrs. Alfred Herbert, Ltd.*).

"Selection of Cutting Fluids," by H. J. Mason (*Messrs. Vauxhall Motors, Ltd.*).

"The Functions of Cutting Fluids," by Professor H. W. Swift, M.A., D.Sc., M.I.Mech.E. (*Sheffield University*).

Tuesday, 1st November, 1938, at 8.0 p.m. at the Chemical Society's Room, Burlington House, Piccadilly, W.1. Joint Meeting with the Road and Building Materials Group, Society of Chemical Industry,

"The Rôle of Surface Tension in Bituminous Substances," by Dr. Ir. F. J. Nellensteyn, Director of the Rijkswegenbouwlaboratorium, Holland.

Tuesday, 8th November, 1938.

"The Search for Oil in Britain." Particulars of this meeting will be announced later.

Monday, 12th December, 1938, Annual Dinner of the Institute at Grosvenor House, Park Lane, London, W.1.

NORTHERN BRANCH.

Thursday, 6th October, 1938. **"The Application of Recent Chemical Research to the Improvement of Petroleum Products,"** by F. B. Thole, D.Sc., F.I.C., F.C.S.

Thursday, 3rd November, 1938. **"Industrial Greases,"** by R. McDonald, B.Sc.

Thursday, 8th December, 1938. **"Light Oil for Automobile Engines,"** by C. G. Williams, M.Sc.

CANDIDATES FOR ADMISSION.

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The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in parentheses.

ANDREWS, Glenn Norton, Chemical Engineer, Refinery, Shell Petroleum Corporation, Wood River, Illinois. (*G. Davidson ; F. L. Garton.*)

BARROW, Leonard Richard, Representative (*Messrs. Townson & Mercer, Ltd.*), 55, Elms Road, Clapham Park, S.W.4. (*L. G. M. Roberts ; C. L. Gilbert.*)

BLACK, John Linton, Chemist, c/o Sarawak Oilfields, Ltd., Miri, Via Singapore. (*J. Kewley ; J. S. Jackson.*) (*Trans. from Student.*)

BROEZE, Johannes Jan, Mechanical Engineer, Proefstation " Delft " Haagweg 126, Delft, Holland. (*J. H. C. de Brey ; B. H. van der Linden.*)

IVANOVSZKY, Leo, Technologist, Porzellangasse 9, Vienna IX, Germany.

JOHNSON, Enoch Cæsar, Asst. Engineer, c/o National Oil Refineries, Ltd., Britannic House, Llandarcy, S. Wales. (*W. C. Mitchell ; E. Thornton.*)

KOENIG, Menko Ludwig Andreas Alais, Chemical Engineer, c/o Bataafsche Petroleum Mij, Carel van Bylandtlaan 30, The Hague, Holland. (*B. H. van der Linden ; J. H. C. de Brey.*)

KYLE, William Galloway, Technical Assistant (*Esso European Laboratories*), Malory House, Featherstone Buildings, W.C.1. (*F. H. Garner ; E. W. Hardiman.*)

MARTIN, Cyril William Grierson, Chemist, c/o Asiatic Petroleum Company, St. Helen's Court, Great St. Helen's, London, E.C.3. (*C. H. Barton ; J. Kewley.*)

WUORELA, Aatto Aleksi, Chemical Engineer, O/Y Nobel Standard A/B, Sodra Kajen 12, Helsingfors, Finland. (*F. H. Garner ; A. Osborn.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Mr. R. E. HALES has left Mexico and is now in Holland.

Mr. H. C. W. JOHNSTON is home from South Africa.

Mr. A. H. RICHARD has returned to Trinidad.

Correspondence or *Journals* forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address: E. C. BROWN, R. A. L. COLE, V. C. S. GEORGESCU, L. GOWER, J. HAKER, J. R. HORTH, A. D. JONES, J. LANDER, I. LUSTY, A. MACLEAN, R. L. MURRAY, S. NICOL, P. E. T. O'CONNOR, M. I. OREVICEANU, N. D. ROTHON, F. J. SCHNEIDER, H. G. SPEARPOINT and A. H. WILLIAMS.

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Kungsgaten 44, Stockholm, Sweden

London Representative: REX LAMBERT, A.R.S.M., 25, Victoria Street, London, S.W.1 Telephone: Victoria 8988

INSTITUTE NOTES.

OCTOBER, 1938.

FORTHCOMING MEETINGS.

Tuesday, 8th November, 1938, 8–11 p.m. at the House of the Royal Geographical Society, Exhibition Road, London, S.W.7. Conversazione and Lecture on **"The Search for Oil in Britain,"** by G. W. Lepper, B.Sc., A.R.C.S., M.Inst.Pet. (Technical Adviser to H.M. Petroleum Department).

The Lecture will be illustrated by exhibits and film. Ladies are invited. Invitation cards will be forwarded on request to the Secretary of the Institute.

Monday, 12th December, 1938. **Annual Dinner of the Institute.** At Grosvenor House, Park Lane, London, W.1.

Tuesday, 13th December, 1938, at 5.30 p.m. at the Royal Society of Arts, John Street, W.C.2. Paper on **"Some Applications of Asphaltic Bitumen in Industry,"** by J. S. Jackson, B.Sc., F.I.C., and the inauguration of an Asphalt Group.

STUDENTS' SECTION.

Thursday, 10th November, 1938. **"Petroleum Products in the Aviation Industry,"** by W. H. Deller (*Student*).

Thursday, 24th November, 1938. **6th Annual Open Meeting.** An address will be given by the Rt. Hon. The Earl de la Warr, P.C.

Thursday, 8th December, 1938. **5th Annual Joint Meeting** with the I.A.E. Graduates' Section and R.Ae.S. Students' Section (*London Branches*).

"Carburation and Induction in Aircraft Engines," by K. C. Hunt, B.Sc., A.C.G.I., at 7 p.m. at the Offices of the I.A.E., 12 Hobart Place, S.W.1.

Tuesday, 20th December, 1938. **"Oiliness,"** by R. D. Streeton (*Student*).

NORTHERN BRANCH.

Thursday, 3rd November, 1938. **"Industrial Greases,"** by R. McDonald, B.Sc.

Thursday, 8th December, 1938. **"Light Oil for Automobile Engines,"** by C. G. Williams, M.Sc.

NOMINATIONS FOR COUNCIL.

Nomination Papers for candidates for election to the Council must be delivered to the Secretary of the Institute not later than Wednesday, 30th November.

Every Member and Associate Member of the Institute may send in writing to the Council the name of a Member whom he desires to recommend for election to the Council. This nomination must be signed by at least nine other Members or Associate Members. No Member or Associate Member may sign more than one Nomination Paper in any one year. (By-Laws, Sect. VIII, 5.)

Nomination Forms are kept at the Institute office for the convenience of Members and will be supplied on request by the Secretary. It is not, however, necessary that these Forms be used. Any nomination which complies with the requirements given above will be considered valid.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institute or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until the lapse of at least one month subsequent to the issue of this *Journal*, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in parentheses.

BOWEN, Clifford Ormond, Chemical Engineer, Anglo-Ecuadorian Oilfields, Ltd., Santa Elena, Ecuador. (*E. A. Evans.*)

HAZZARD, Geoffrey Francis, Chemist, Arend Petroleum Maatschappij, Aruba, N.E.I. (*Percy Meyer ; J. S. Jackson.*) (*Trans. from Student.*)

KNOX, James, Engineer, Anglo-Iranian Oil Co., Ltd., Abadan, S. Iran. (*R. Crichton ; A. E. Dunstan.*)

MARSHALL, Rees William, Engineer, Royal Army Service Corps Mess, Feltham, Middlesex. (*W. C. Mitchell ; A. C. Hartley.*)

PAYNE, Clarence Sydney, Engineering Research Manager (*British Oil and Turpentine Corpn, Ltd.*), 16 Burlington Avenue, Kew, Surrey. (*J. G. Hunter ; J. V. Delves.*)

SCOTT, Thornton, Chemist (*Refiners, Ltd.*), 17 Victoria Avenue, Didsbury, Manchester. (*H. Moore ; W. H. Hoffert.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Lt.-Col. S. J. M. AULD has been elected an Honorary Member of the Chemical, Metallurgical and Mining Society of South Africa.

Dr. C. E. NABUCO DE ARAUJO JOR has been re-elected President of the Syndicato dos Chimicos do Rio de Janeiro, Brazil.

Mr. H. A. HARRIS has returned to Trinidad.

Mr. R. L. S. PANISSET has left for Egypt.

Mr. J. A. SMITS has left Holland for the U.S.A.

Mr. L. K. WHITE has returned to Trinidad.

Correspondence or *Journals* forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address: E. C. BROWN, R. A. L. COLE, O. C. ELVINS, V. C. S. GEORGESCU, J. HAKER, J. R. HORTH, A. D. JONES, J. LANDER, I. LUSTY, A. MACLEAN, R. L. MURRAY, S. NICOL, P. E. T. O'CONNOR, M. I. OREVICEANU, N. D. ROTHON, F. J. SCHNEIDER, H. G. SPEARPOINT and A. H. WILLIAMS.

INSTITUTE NOTES.

NOVEMBER 1938.

ELECTION OF PRESIDENT.

The Council has elected PROFESSOR A. W. NASH, M.Sc., M.I.Mech.E., M.I.Chem.E., F.C.S., to be President of the Institute for the Session 1939/1940. PROFESSOR NASH, who will take office at the Annual General Meeting in 1939, has been a Member of the Institute since 1914. He was first elected to the Council in 1925 and has been Vice-President since 1934.

FORTHCOMING MEETINGS.

Monday, 12th December, 1938. **Annual Dinner of the Institute,** at Grosvenor House, Park Lane, London, W.1. 7.0 p.m. for 7.30 p.m. Tickets 12*s.* 6*d.* (exclusive of wines).

Tuesday, 13th December, 1938, at 5.30 p.m., at the Royal Society of Arts, John Street, W.C.2. Paper on **"Some Applications of Asphaltic Bitumen in Industry,"** by J. S. Jackson, B.Sc., F.I.C., and the Inauguration of an Asphaltic Bitumen Group.

Tuesday, 10th January, 1939, at 5.30 p.m., at the Royal Society of Arts, John Street, W.C.2. **"Tank Strapping,"** by Peter Kerr, M.A., B.Sc., A.I.C. Advance copies of this paper will be available in December.

Preliminary Announcement.

22nd–24th May, 1939. The Summer Meeting of the Institute will be held at Birmingham. The programme of the meeting will be published early in 1939.

STUDENTS' SECTION.

Thursday, 8th December, 1938. **5th Annual Joint Meeting** with the I.A.E. Graduates' Section and R.Ae.S. Students' Section (*London Branches*). **"Carburation and Induction in Aircraft Engines,"** by K. C. Hunt, B.Sc., A.C.G.I., at 7 p.m., at the Offices of the I.A.E., 12 Hobart Place, S.W.1.

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Nomination Papers for candidates for election to the Council must be delivered to the Secretary of the Institute not later than Wednesday, 30th November.

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Nomination Forms are kept at the Institute office for the convenience of Members and will be supplied on request by the Secretary. It is not, however, necessary that these Forms be used. Any nomination which complies with the requirements given above will be considered valid.

NEW MEMBERS.

The following elections were made by the Council in accordance with the By-Laws, Section IV, Para. 7, at the Council Meeting held on Thursday, 17th November, 1938.

Elections are subject to confirmation in accordance with the By-Laws, Section IV, paras. 9 and 10.

Members.

Andrew, Frank	Cheshire.
Andrews, Glenn Norton	Illinois.
Broeze, Johannes Jan	Holland.
Cooper, Stanley Charles Richard	Roumania.
Dennis, Cyril Frederick	London.
Farquharson, Douglas Ian	Trinidad.
Harrison, John Alfred	Coventry.
Krause, William F.	Illinois.
Johnson, Enoch Cæsar	Llandarcy.
Koenig, Menko Ludwig Andreas Alais	Holland.
Metcalfe, James Vivian	S. Africa.
Rayner, Cyril Kentish	Iran.
Tanaka, Yoshio	Japan.
Waterford, Leo Mengersen	Australia.
Wuorela, Aatto Aleksi	Helsingfors.

Transfer to Members.

Dickinson, George	Venezuela.
Ettlinger, Ernest Hjalmar	London.
Martin, Cyril William Grierson	London.
Taylor, John Leslie	London.
Trim, Frederick Aine	Germany.

Associate Members.

Aickin, Robert Geoffrey	Australia.
Barrow, Leonard Richard	London.
Darbyshire, Sydney	Wigan.
Emery, Douglas John	Woodford Green.
Macdonald, Hector Goring	Glasgow.
Neppe, Solly Louis	S. Africa.
Newby, William John	Iran.
Priest, Ernest Horace	Tolworth.
Schiffman, Eric Charles	S. Africa.
St. Hilaire, Frank Desmond	Trinidad.

Transfer to Associate Member.

Black, John Linton	Sarawak.

Students.

Kyle, William Galloway	London.
de Waele, John Pierre Armand	London.
Young, Laurence Maclellan	Cambridge.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institute or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until the lapse of at least one month subsequent to the issue of this *Journal*, during which time any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in parentheses.

BRAUNE, Bernhard, Physicist, c/o Dr. C. Ottos Comp. Christstr. 9, Bochum, Germany. (*F. A. Trim ; E. N. Hague.*)

CAPLAN, Barry, Student (*Vacuum Oil Company*), 42, Ashbourne Avenue, Golders Green, N.W.11. (*S. J. M. Auld ; N. G. Gullick.*)

COLLINS, William Thomas, Technical Representative (*Lobitos Oilfields, Ltd.*), 251, Parrs Wood Road South, Didsbury, Manchester, 20. (*J. S. Parker ; D. M. Glendinning.*)

CROSSFIELD, Arthur, Chemist (*Shell Marketing Company*), Hornsey Y.M.C.A., Tottenham Lane, London, N.8. (*J. S. Jackson ; J. Parrish.*)

FARRANT, Victor Matthew, Sales Manager (*Manchester Oil Refineries, Ltd.*), 54, Ullswater Road, Flixton, Lancs. (*E. J. Dunstan ; B. J. Vavasour.*)

FRANK, Fritz, Chemist, 25/26, Hanover Square, London, W.1. (*A. E. Dunstan ; J. Kewley.*)

HILTON, Charles James, Mechanical Engineer, c/o T.P.D. Co., Ltd., Palo Seco, Trinidad, B.W.I. (*L. K. White ; I. McCallum.*)

HYAMS, Harry, Technologist, c/o Asiatic Petroleum Co., Ltd., St. Helens Court, Great St. Helens, E.C.3. (*J. Kewley ; W. W. Goulston*) (*Trans. from Associate Member.*)

IVANOFF, Alexander, Engineer (*Hayward-Tyler & Co., Ltd.*), 67, Trinity Road, Luton, Beds. (*G. P. E. Howard ; F. E. Howard.*)

LEVI, Richard, Chemist (*Manchester Oil Refinery, Ltd.*), 63, High Lane, Chorlton-c.-Hardy. (*E. J. Dunstan ; B. J. Vavasour.*)

MCCUE, Cyril Frederick, Chemist (*Anglo-American Oil Co., Ltd.*), 25, Chesfield Road, Kingston-on-Thames. (*H. C. Tett ; C. Chilvers.*)

NICHOLSON, Ian Howard Grant, Engineer, c/o Shell Co. of S.A., Ltd., P.O. Box 4578, Johannesburg, South Africa. (*J. Kewley ; N. Mitchell.*)

STEEL, George Reginald, Trainee (*Lambert Bros., Ltd.*), "Hooklands," Scaynes Hill, Nr. Hayward's Heath, Sussex. (*E. J. Dunstan ; B. J. Vavasour.*)

UNMACK, Edward West, Branch Manager, c/o Shell-Mex & B.P., Ltd., Sunlight House, Quay Street, Manchester. (*J. E. Haslam ; A. McCulloch.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Dr. A. E. DUNSTAN has been elected an Honorary Member of the Association Française des Techniciens du Pétrole.

Mr. P. EVANS is home from India.

Mr. F. R. S. HENSON has returned to Iraq.

Mr. F. E. HUNTER is now in Trinidad.

Mr. H. T. LORNE is home from Iran.

Mr. A. W. H. PHELPS is returning to Ceylon.

Mr. E. E. UPTON is in Syria.

Mr. J. WATSON has left for Assam.

Mr. A. T. WRAY is now in Iran.

Correspondence or *Journals* forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address: E. C. BROWN, K. BURTON, R. A. L. COLE, O. C. ELVINS, V. C. S. GEORGESCU, J. HAKER, J. J. L. HAMILTON, J. R. HORTH, A. D. JONES, J. LANDER, H. R. LOVELY, I. LUSTY, A. MACLEAN, C. A. MOON, R. L. MURRAY, S. NICOL, P. E. T. O'CONNOR, M. I. OREVICEANU, H. G. SPEARPOINT, H. C. V. VINCENT and A. H. WILLIAMS.

18TH INTERNATIONAL GEOLOGICAL CONGRESS.

Preliminary details of the 18th International Geological Congress to be held in London from 31st July to 8th August, 1940, have been circularized to all members of the Institute of Petroleum. Copies of the first circular may be obtained from the General Secretaries, 18th International Congress, Geological Survey & Museum, South Kensington, London, S.W.7.

The following members of the Institute are members of the General Organizing Committee of the Congress :—

The President of the Institute of Petroleum.
Sir William Bragg, O.M., K.B.E.,
The Rt. Hon. Lord Cadman, G.C.M.G.,
Sir Thomas H. Holland, K.C.S.I., K.C.I.E.,
Prof. P. G. H. Boswell, O.B.E., D.Sc.,
T. Dewhurst, Esq.,
Prof. V. C. Illing, M.A.,
Dr. G. M. Lees, M.C., D.F.C.

Prof. P. G. H. Boswell, Prof. V. C. Illing and Dr. G. M. Lees are members of the Executive Committee.

The Executive Committee of the Congress feels assured that many geologists who have not yet replied to the first circular intend being present at the Congress in 1940, and wishes to emphasize the desirability of sending a reply to the first circular as early as possible. It will facilitate the work of those responsible for the organization of the Congress if they know the approximate numbers of those proposing to attend.

Third Edition

APPLIED GEOPHYSICS

IN THE SEARCH FOR MINERALS

By A. S. EVE and D. A. KEYS

112 text-figures. 16*s*. net.

In the third edition some modifications have been made, and a chapter has been added dealing with the chief advances during the past six years.

" The book should be invaluable to all interested in applied geophysics, including the specialist, who will turn to it repeatedly. This is not a book to lie at rest on the library shelf, but one to be read with enjoyment and then treated as a constant source of reference on all questions on this fascinating subject."—*Nature*.

CAMBRIDGE UNIVERSITY PRESS

Kindly mention this Journal when communicating with Advertisers.

INSTITUTE NOTES.

DECEMBER 1938.

ELECTION OF VICE-PRESIDENTS.

The Council has elected the following as Vice-Presidents of the Institute for the Session 1939–1940 :—

ASHLEY CARTER, A.M.I.Mech.E.
C. DALLEY, M.I.E.E.
F. H. GARNER, Ph.D., M.Sc., F.I.C.
J. MCCONNELL SANDERS, F.I.C., F.C.S.
F. B. THOLE, D.Sc., F.I.C., F.C.S.

SPECIAL GENERAL MEETING.

A Special General Meeting of the Institute will be held at 5.30 p.m. on Tuesday, 10th January, 1939, at the Royal Society of Arts, John Street, W.C. 2, for the purpose of approving the proposals of the Council regarding re-classification of the present membership into the new categories of Fellows, Members and Associate Members. A Notice of the Meeting and the text of the Special Resolutions to be proposed have been posted to every member of the Institute.

FORTHCOMING MEETINGS.

Tuesday, 10th January, 1939, at 5.45 p.m., at the Royal Society of Arts, John Street, W.C.2. **"Tank Strapping,"** by Peter Kerr, M.A., B.Sc., A.I.C. Advance copies of this paper are available on request.

Preliminary Announcement.

22nd–24th May, 1939. The **Summer Meeting** of the Institute will be held at Birmingham. The programme of the meeting will be published early in 1939.

Northern Branch.

Thursday, 19th January, 1939, at Ellesmere Port. **"Modern Methods Applied to the Manufacture of Lubricating Oils,"** by E. J. Dunstan, M.Sc.

Thursday, 16th February, 1939. **Annual Dinner and Dance** at the Midland Hotel, Manchester.

Scottish Branch.

Friday, 20th January, 1939. Inaugural Meeting of the Scottish Branch. Address by the President, Lt.-Col. S. J. M. Auld, O.B.E., M.C., D.Sc.: **"New Light on Lubrication."** This meeting will be held at the North British Hotel, Edinburgh. Full particulars can be obtained from Prof. W. M. Cumming, D.Sc., Royal Technical College, Glasgow.

NEW MEMBERS.

The following elections were made by the Council in accordance with the By-Laws, Section IV, para. 7, at the Council Meeting held on Thursday, 8th December, 1938.

Elections are subject to confirmation in accordance with the By-Laws, Section IV, paras. 9 and 10.

Members.

MARSHALL, Rees William	London.
PAYNE, Clarence Sydney	Surrey.
SCOTT, Thornton	Manchester.

Associate Members.

BOWEN, Clifford Ormond	S. America.
KNOX, James	Iran.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institute or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until the lapse of at least one month subsequent to the issue of this *Journal*, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in parentheses.

BRUIJN, Jan Antonie de, Chemical Engineer (*Delft University*), Middellandplein 13b, Rotterdam-Centrum, Holland. (*H. I. Waterman.*)

CUMMING, William Murdoch, "Young" Professor of Technical Chemistry, The Royal Technical College, Glasgow. (*S. J. M. Auld ; A. E. Dunstan.*)

DOWN, Arthur Lewis, Research Student, 87, Plains Avenue, Maidstone, Kent. (*A. C. Egerton ; G. W. Himus.*)

DRAPER, Philip, Chartered Mechanical Engineer (*Asiatic Petroleum Co., Ltd.*), St. Helen's Court, London, E.C.3. (*J. Kewley ; N. Mitchell.*)

GRANT, James, Petroleum Technologist (*Anglo-Egyptian Oilfields, Ltd.*), The Refinery, Suez, Egypt. (*J. Kewley ; C. O. F. Jenkin.*)

HETMAT, Hossein Khan, Student, 88, Queensway, Bayswater, W.2. (*V. C. Illing.*)

HORNE, Donald, Chemist (*Low Temperature Carbonisation Distillates, Ltd.*), 28, Oxcroft Lane, Bolsover, nr. Chesterfield. (*G. S. Pound ; R. V. Wheeler.*)

HULTGREN, Axel I., Oil Field Engineer (*Compania Ferrocarrilera de Petroleo*), Comodoro Rivadavia, Argentine. (*E. P. Senior ; C. Hargreaves.*)

MOORE, John Lawson, Sales Trainee (*Asiatic Petroleum Co., Ltd.*), St. Helen's Court, E.C.3. (*J. Kewley ; W. W. Goulston.*)

NEALE-MAY, William Montague, Chief Operator, P.O. Box 83, Boksburg North, S. Africa. (*F. Stephenson.*)

NERCESSIAN, Vahram, Technical Assistant (*Iraq Petroleum Company, Ltd.*), Kirkuk, Iraq. (*E. A. Satchell, G. J. Perks.*)

REID, William, Mining Engineer, Foulford House, Cowdenbeath. (*R. Crichton ; G. H. Smith.*)

SEMMENS, Graham Corkill, Learner Driller (*Central Drilling Department, T.L.L.*), Pointe-a-Pierre, Trinidad, B.W.I. (*J. L. Harris ; T. M. L. Tindall.*)

STEHMAN, Carlyle John, Research Chemist (*Monsanto Chemical Co.*), Dayton, Ohio. (*M. R. Fenske ; K. A. Varteressian.*)

TURNER, Bernard Evelyn, Boileau, Petroleum Technologist (*Shell-Mex & B.P. Motor Oils, Ltd.*), 52, Skeena Hill, London, S.W.18. (*V. V. L. Hope ; H. E. Priston.*)

Candidates for election as Students.

BALDWIN, Alan Henry, 316A, Sarehole Road, Hall Green. (*A. Nash ; L. V. W. Clark.*)

BARBER, Bernard Thomas, Chancellor's Hall, Edgbaston, Birmingham. (*A. Nash ; L. V. W. Clark.*)

BEAUMONT, Geoffrey Keith, Chancellor's Hall, Edgbaston, Birmingham. (*A. W. Nash ; L. V. W. Clark.*)

BROWN, Thomas, 101 Oakfield Road, Selly Park. (*A. W. Nash ; L. V. W. Clark.*)

BRUNNER, Donald George, 292 Lordswood Road, Harborne. (*A. W. Nash; L. V. W. Clark.*)

DAFT, Victor Donovan, 20, Edgbaston Road, Birmingham. (*A. W. Nash ; L. V. W. Clark.*)

DAVIS, Alec Kenneth, 160, Bournbrook Road. (*A. W. Nash ; L. V. W. Clark.*)

DIXON, John Frederick, Chancellor's Hall. (*A. W. Nash ; L. V. W. Clark.*)

GEORGE, Henry George, 21, Kelmscott Road, Harborne. (*A. W. Nash ; L. V. W. Clark.*)

GREGSON, Hayse Dennis, 79, Oakfield Road, Selly Park. (*A. W. Nash ; L. V. W. Clark.*)

HOWARD, Frederick George, 101, Oakfield Road, Selly Park. (*A. W. Nash ; L. V. W. Clark.*)

IRELAND, Gilbert Robert, 875, Pershore Road, Birmingham. (*A. W. Nash ; L. V. W. Clark.*)

JU, Ting Y, 68, Summerfield Crescent, Edgbaston. (*A. W. Nash ; L. V. W. Clark.*)

LAUCKNER, Frank Godfrey, 276, Pershore Road, Birmingham. (*A. W. Nash ; L. V. W. Clark.*)

LONGBOTTOM, Frank William, 133, Selly Park Road, Selly Park. (*A. W. Nash ; L. V. W. Clark.*)

LUCIE-SMITH, Geoffrey Ross, 79, Oakfield Road, Birmingham 29. (*A. W. Nash ; L. V. W. Clark.*)

NAGHAVI, Said, 11, Park Hill Road, Harborne. (*A. W. Nash ; L. V. W. Clark.*)

OWEN, Peter Benedict, 39, Linchmere Road, Handsworth. (*A. W. Nash ; L. V. W. Clark.*)

PERKS, John Gilbert, 66, Victoria Road, Sutton Coldfield. (*A. W. Nash ; L. V. W. Clark.*)

WILLIAMS, Harold Robert, Chancellor's Hall. (*A. W. Nash ; L. V. W. Clark.*)

WILLMOTT, Ivor Alan, 61, Selly Park Road, Selly Park. (*A. W. Nash ; L. V. W. Clark.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Mr. H. E. CHARLTON is home from Italy.

Mr. C. S. CLEVERLY has left Iran and is now in Palestine.

Mr. W. DUFF is home from South Africa.

Dr. J. A. L. HENDERSON is home from Canada.

Mr. F. S. SMITH has returned to Mexico.

Correspondence or *Journals* forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address: E. C. BROWN, K. BURTON, O. C. ELVINS, V. C. S. GEORGESCU, J. J. L. HAMILTON, J. R. HORTH, A. D. JONES, J. LANDER, H. R. LOVELY, I. LUSTY, A. MACLEAN, C. A. MOON, R. L. MURRAY, S. NICOL, M. I. OREVICEANU, H. G. SPEARPOINT, H. C. V. VINCENT and A. H. WILLIAMS.

*

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Papers and Articles.—The Council invites Papers and Articles both for reading at Ordinary Meetings of the Institution and for publication in the *Journal*. All Papers, whether for reading or publication, will be submitted to a referee appointed by the Publication Committee.

The Institute has published a brochure "Instructions for the Guidance of Authors" containing details of recommended practice in the preparation of Papers for publication. Copies of this brochure will be supplied on request.

Pre-Prints.—Advance proofs of Papers to be read at Ordinary Meetings are generally available about a week before the Meeting. Members wishing to be supplied with these pre-prints are requested to notify the Secretary.

Abstracts.—Members and Journal Subscribers desirous of receiving the Abstracts printed on one side of the paper only, can be supplied with these at a charge of 10*s.* per annum per copy, payable in advance.

Issue of Journal.—Members whose subscription is not in arrear receive the *Journal* free of cost. A member whose subscription is not paid by March 31st of the year for which it is due is considered to be in arrear.

Changes of Address.—Members are requested to notify any change of address to the Secretary.

Benevolent Fund.—The Benevolent Fund is intended to aid necessitous persons who are or have been members of the Institute, and their dependent relatives.

The Fund is raised by voluntary annual subscriptions, donations, and bequests, and all contributions should be sent to the Secretary of the Institute at The Adelphi, London, W.C. 2. The Fund is administered by the Council through the Benevolent Fund Committee, and all applications in connection therewith must be made on a special form which can be obtained from the Secretary of the Institute.

Appointments Register.—A register of members requiring appointments is kept at the offices of the Institute, and every effort is made to assist members of the Institute in search of employment.

Members who desire their names and qualifications to be included in this register are requested to apply to the Secretary for the Form of Application for Registration, if they have not already done so. Members residing in the London area are asked, if possible, to return this Form in person and make themselves known, together with their requirements, to the Secretary. It is also requested that members should notify the Secretary immediately they have obtained an appointment.

In submitting names of candidates to prospective employers it is understood that the Institute accepts no responsibility and gives no guarantee.

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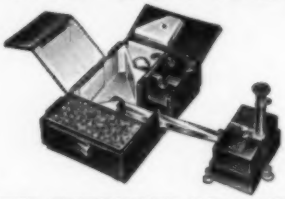

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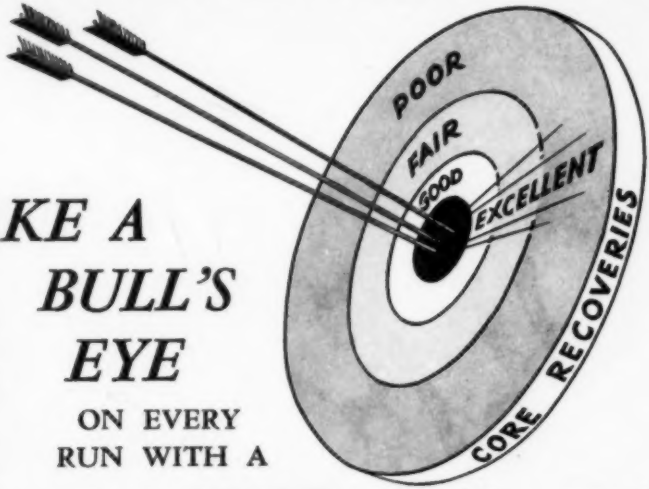

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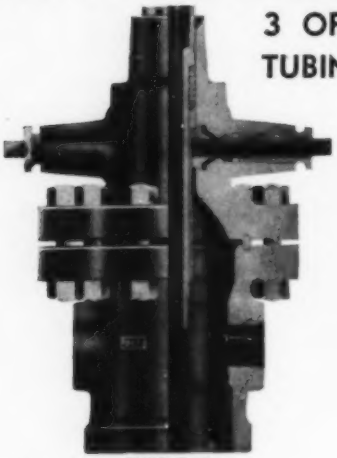
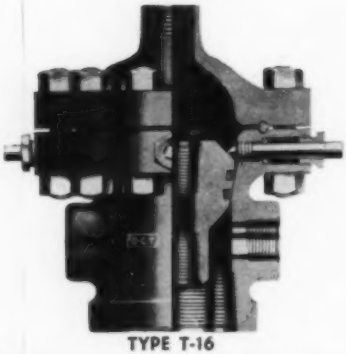


TYPE T-19

Retractable hanger seats permit tubing collars and tubing hanger to pass through head to facilitate washing behind liner and setting packer. After drilling plug and running two joints of tubing with liner and packer, blowout preventer is replaced by Christmas tree made up on top of Tubing Head connection, which is stripped over tubing and installed on body of head. O-C-T Stripper Rubber Blowout Preventer installed above Christmas tree permits running tubing to bottom in safety, collars and hanger passing through stripper rubber which serves as a stuffing box while washing behind liner. After washing and setting packer, tubing is raised to suspension point and retractable seats screwed in to engage hanger.



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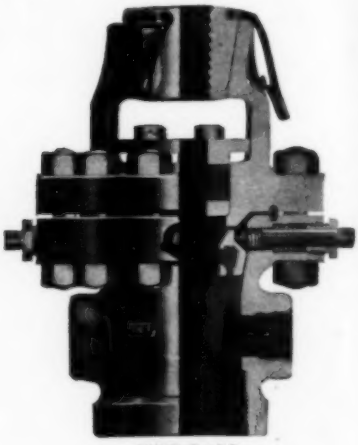

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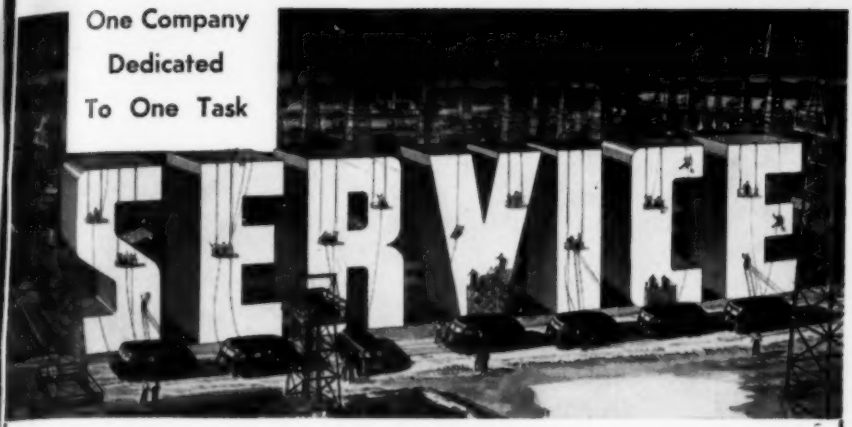

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The Superior Oil Company's deep well at Rio Bravo, California, was double surveyed when at a depth of 11,322 feet with the "SURWEL" Gyroscopic Clinograph attached to the drill pipe making the round trip in 5½ hours.

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FROM THE LOG

In-run started at 9h 28m 00sec.

Bottom reached at 11h 41m 00sec.

Out-run completed at 2h 55m 00sec.

Total time for two surveys . . . 5h 27m 00sec.

Closure between In and Out-run . . . . . 6.1'

Maximum temperature recorded. . . . . 218°F.

Records taken every 45 feet.

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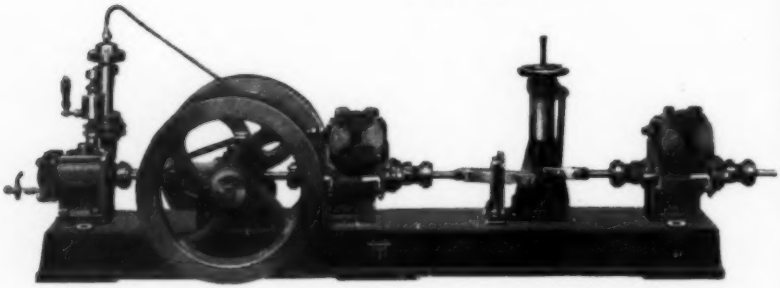

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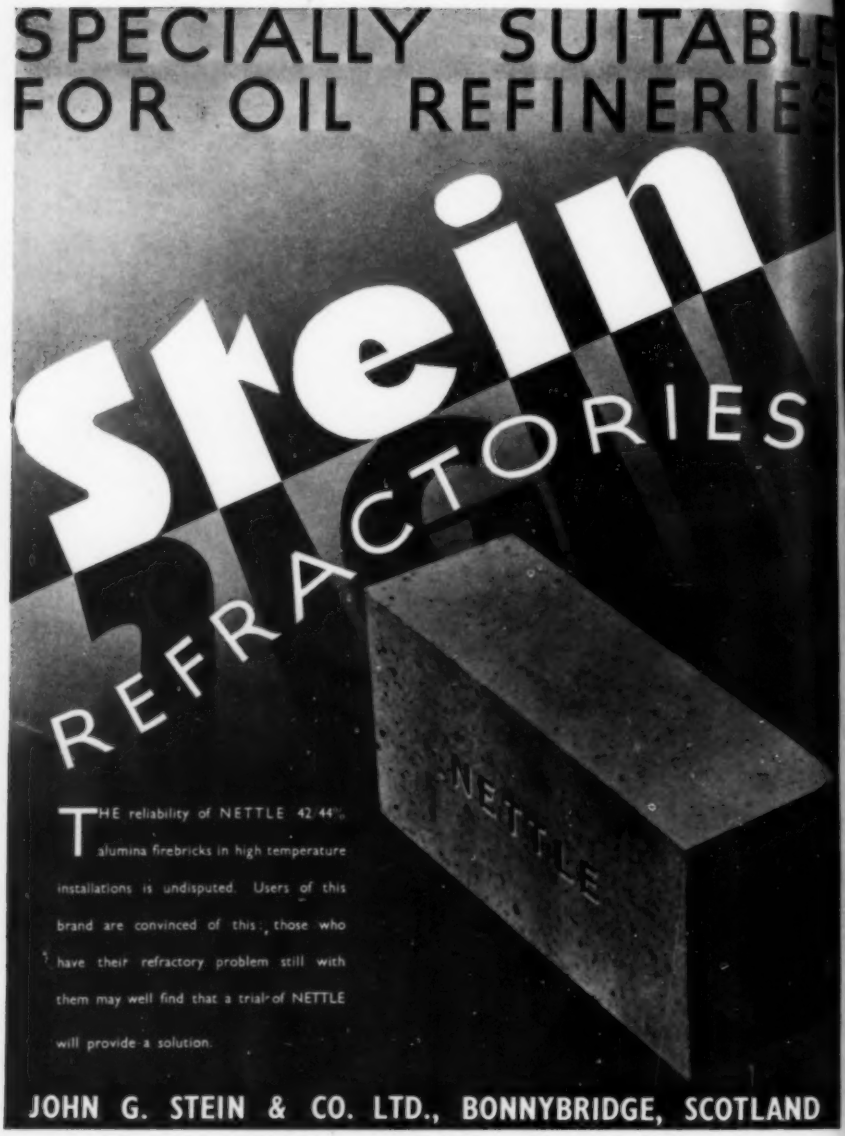
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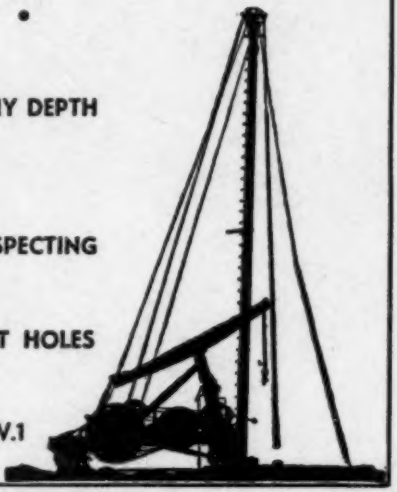

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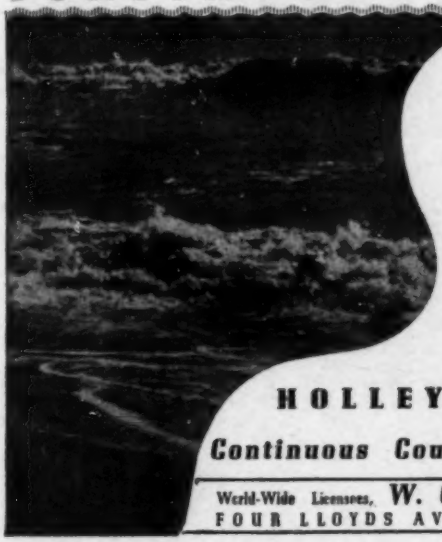

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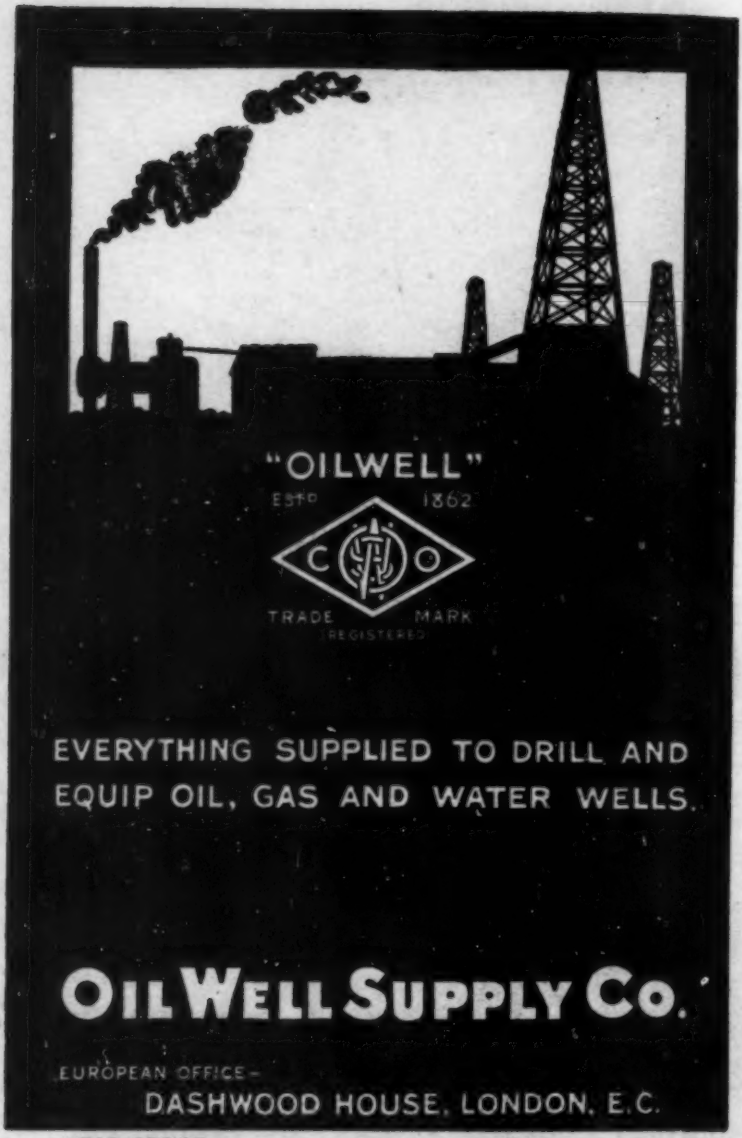

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